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ENGINEERING DATA

ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

STUDY OF OTTAWA SYSTEM

WALTER J. FRANCIS & COMPANY

CONSULTING ENGINEERS



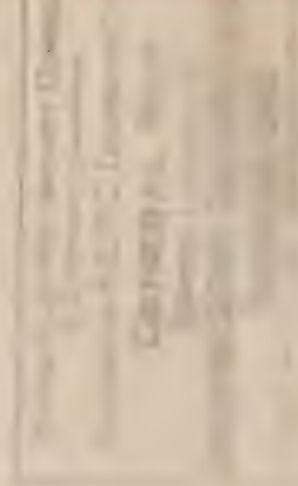
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OTTAWA SYSTEM

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MEASUREMENTS

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Appendix A contains the following information:

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2. A list of the items used in the study.

3. A list of the items used in the study.

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Toronto, Ontario.

April 20th, 1923.

Hydro-Electric Inquiry Commission,

W. D. Gregory, Esq., Chairman.

T O R O N T O, Ontario.

re Studies of Engineering Economics of the
Ottawa System of the
Hydro-Electric Power Commission of Ontario

Mr. Chairman and Gentlemen,-

In accordance with the letter to your Commission under date of November 4th, 1922, and your confirmation of the general instructions under date of November 15th, 1922, a study has been made of the engineering economics of the Ottawa System of electrical generation and distribution operated by the Hydro-Electric Power Commission of Ontario. The work has been done under the direct personal supervision of Mr. Frederick B. Brown, M. Sc., M.E.I.C., a partner in the firm of Walter J. Francis & Company, in accordance with your instructions.

The subject has been discussed with Mr. Commissioner E. A. Ross in detail, and, generally, with Mr. Bower, the Secretary of your Commission, and constant communication has been maintained with the officials of the Hydro-Electric Power Commission of Ontario.

The reports of Messrs. Price, Waterhouse & Co. have been used as the basis of the financial figures given herein, and reference has been made to the records of the Hydro-Electric Power Commission of Ontario where it was necessary to do so to prepare the diagrams.

It is understood that it is not within the scope of the instructions to examine into any of the legal aspects of the System nor discuss any of the Acts of the Legislature relating to it.

The necessary technical data has required considerable preparation, as much of it is only available in the operating records of the Hydro-Electric Power Commission of Ontario. The printed reports contain a part, but these have had to be supplemented by interviews with various officials, and by searching the voluminous records both at the head office in Toronto and elsewhere.

The general plan under which the report of the studies is presented may be outlined as follows:

COPY

- (1) A short review of the history and evolution of the System.
- (2) A brief physical description of the System.
- (3) A brief discussion regarding the characteristics of the market.
- (4) A discussion of progressive capital costs.
- (5) Statistics regarding progressive revenues, with discussion thereon.
- (6) Statistics regarding progressive operating costs and fixed charges, with discussion thereon.
- (7) Statistics showing progressive and accumulated deficits or surpluses, with discussion thereon.
- (8) Analysis of progressive operating records and of unit revenues per horse-power per annum and of unit costs per horse-power per annum.
- (9) A brief discussion of the various important points concerning the System.

It is suggested that it is not within the scope of this investigation to examine any of the legal aspects of the system and should be left

out of similar circumstances, only to show

For example, the following table shows the results of a regression analysis of the relationship between the number of hours worked and the number of children in the household.

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1. The first step is to identify the problem or question that needs to be answered. This involves understanding the context and the specific requirements of the task.

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- *Journal of Statistical Software* 1993, 1:1-13. <http://www.stat.columbia.edu/jstatsoft/>

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- RECEIVED: JULY 24, 1984; REVISED: SEPTEMBER 10, 1984; ACCEPTED: SEPTEMBER 10, 1984.

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The report included herewith as pages 4 to 46 inclusive refers in detail to that portion of the activities of the Hydro-Electric Power Commission known as the Ottawa System. Reference has been made to the possible inter-connection of this System with other Systems in the future.

Throughout the report diagrams have been included in the order of the text, while the map included as a frontispiece shows the System generally and its geographical relation to all the other Systems operated by the Hydro-Electric Power Commission of Ontario.

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OTTAWA SYSTEM

Frederick B. Brown, M. Sc.

Evolution and Development of the System.

City of Ottawa.

The Ottawa System had its inception on July 31st, 1907, when the Hydro-Electric Power Commission contracted with the City of Ottawa to supply the power required for its municipal operations. On the same day, the Commission signed a contract with the Ottawa & Hull Power & Manufacturing Company to purchase sufficient electric power to meet the requirements of the Corporation of the City of Ottawa. Under this contract the Ottawa & Hull Power & Manufacturing Company agreed to sell to the Hydro-Electric Power Commission of Ontario 1,500 electrical horse-power at the flat rate of \$15.00 per horse-power year, and to supply additional power at the same rate up to 1,000 horse-power, making a maximum of 2,500 horse-power. The period of the contract was ten years and in it the Company agreed to deliver the power to the Corporation of the City of Ottawa at the city limits at Chaudiere Bridge.

The power requirements of the Municipal Corporation of the City of Ottawa increased very rapidly and soon exceeded the maximum amount available under the contracts mentioned above, and on December 6th, 1910, amendments to both these agreements were signed and made effective, increasing the maximum horse-power available to 4,000 horse-power at the same rate of

1882 1883 1884 1885 1886 1887 1888 1889 1890 1891 1892 1893 1894 1895 1896 1897 1898 1899 1900 1901 1902 1903 1904 1905 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950 1951 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2069 2070 2071 2072 2073 2074 2075 2076 2077 2078 2079 2080 2081 2082 2083 2084 2085 2086 2087 2088 2089 2090 2091 2092 2093 2094 2095 2096 2097 2098 2099 2100 2101 2102 2103 2104 2105 2106 2107 2108 2109 2110 2111 2112 2113 2114 2115 2116 2117 2118 2119 2120 2121 2122 2123 2124 2125 2126 2127 2128 2129 2130 2131 2132 2133 2134 2135 2136 2137 2138 2139 2140 2141 2142 2143 2144 2145 2146 2147 2148 2149 2150 2151 2152 2153 2154 2155 2156 2157 2158 2159 2160 2161 2162 2163 2164 2165 2166 2167 2168 2169 2170 2171 2172 2173 2174 2175 2176 2177 2178 2179 2180 2181 2182 2183 2184 2185 2186 2187 2188 2189 2190 2191 2192 2193 2194 2195 2196 2197 2198 2199 2200 2201 2202 2203 2204 2205 2206 2207 2208 2209 2210 2211 2212 2213 2214 2215 2216 2217 2218 2219 2220 2221 2222 2223 2224 2225 2226 2227 2228 2229 2230 2231 2232 2233 2234 2235 2236 2237 2238 2239 2240 2241 2242 2243 2244 2245 2246 2247 2248 2249 2250 2251 2252 2253 2254 2255 2256 2257 2258 2259 2260 2261 2262 2263 2264 2265 2266 2267 2268 2269 2270 2271 2272 2273 2274 2275 2276 2277 2278 2279 2280 2281 2282 2283 2284 2285 2286 2287 2288 2289 2290 2291 2292 2293 2294 2295 2296 2297 2298 2299 2300 2301 2302 2303 2304 2305 2306 2307 2308 2309 2310 2311 2312 2313 2314 2315 2316 2317 2318 2319 2320 2321 2322 2323 2324 2325 2326 2327 2328 2329 2330 2331 2332 2333 2334 2335 2336 2337 2338 2339 2340 2341 2342 2343 2344 2345 2346 2347 2348 2349 2350 2351 2352 2353 2354 2355 2356 2357 2358 2359 2360 2361 2362 2363 2364 2365 2366 2367 2368 2369 2370 2371 2372 2373 2374 2375 2376 2377 2378 2379 2380 2381 2382 2383 2384 2385 2386 2387 2388 2389 2390 2391 2392 2393 2394 2395 2396 2397 2398 2399 2400 2401 2402 2403 2404 2405 2406 2407 2408 2409 2410 2411 2412 2413 2414 2415 2416 2417 2418 2419 2420 2421 2422 2423 2424 2425 2426 2427 2428 2429 2430 2431 2432 2433 2434 2435 2436 2437 2438 2439 2440 2441 2442 2443 2444 2445 2446 2447 2448 2449 2450 2451 2452 2453 2454 2455 2456 2457 2458 2459 2460 2461 2462 2463 2464 2465 2466 2467 2468 2469 2470 2471 2472 2473 2474 2475 2476 2477 2478 2479 2480 2481 2482 2483 2484 2485 2486 2487 2488 2489 2490 2491 2492 2493 2494 2495 2496 2497 2498 2499 2500 2501 2502 2503 2504 2505 2506 2507 2508 2509 2510 2511 2512 2513 2514 2515 2516 2517 2518 2519 2520 2521 2522 2523 2524 2525 2526 2527 2528 2529 2530 2531 2532 2533 2534 2535 2536 2537 2538 2539 2540 2541 2542 2543 2544 2545 2546 2547 2548 2549 2550 2551 2552 2553 2554 2555 2556 2557 2558 2559 2560 2561 2562 2563 2564 2565 2566 2567 2568 2569 2570 2571 2572 2573 2574 2575 2576 2577 2578 2579 2580 2581 2582 2583 2584 2585 2586 2587 2588 2589 2590 2591 2592 2593 2594 2595 2596 2597 2598 2599 2600 2601 2602 2603 2604 2605 2606 2607 2608 2609 2610 2611 2612 2613 2614 2615 2616 2617 2618 2619 2620 2621 2622 2623 2624 2625 2626 2627 2628 2629 2630 2631 2632 2633 2634 2635 2636 2637 2638 2639 2640 2641 2642 2643 2644 2645 2646 2647 2648 2649 2650 2651 2652 2653 2654 2655 2656 2657 2658 2659 2660 2661 2662 2663 2664 2665 2666 2667 2668 2669 2670 2671 2672 2673 2674 2675 2676 2677 2678 2679 2680 2681 2682 2683 2684 2685 2686 2687 2688 2689 2690 2691 2692 2693 2694 2695 2696 2697 2698 2699 2700

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\$15.00 per horse-power year.

The load of the City of Ottawa continued to increase rapidly. In 1912 about 3,100 horse-power was being purchased, and by the end of 1913 the demand again exceeded the total amount included in the contracts, thus necessitating further provision for power.

An agreement between the Commission and the Ottawa & Hull Power & Manufacturing Company was drawn up on December 8th, 1913, superseding all previous agreements between the two parties and providing for the delivery of from 5,000 horse-power to 20,000 horse-power, at rates ranging from \$14.00 per horse-power for the minimum requirements to \$11.00 per horse-power when the load on the System will have reached 18,000 horse-power. This agreement is to remain in force for a period of thirteen years, and provides, at the option of the Commission, for its renewal for one or two further terms of ten years, notice to be given to the Company by the Commission of its intention to renew the agreement at least two years before the expiration of the term of years then in force. Excerpts from this document are contained in further detail in Exhibit II of the Price, Waterhouse & Co. report on "Investigation of Accounts of Ottawa System" dated November 7th, 1922.

The Order-in-Council approving this agreement is dated March 4th, 1914, and is as follows:

"Upon the recommendation of the Hydro-Electric Power Commission of Ontario, the Committee of Council advise that the accompanying contract entered into between the Ottawa & Hull Power & Manufacturing Company and the said Commission, bearing date the eighth day of December, 1913, for the supply of from 5,000 to 18,000 horse-power of electrical power at or near the Corporation of the City of Ottawa, be approved by Your Honour."

Further provision was made.

10-10-1964

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be approved by Your Honor."

On February 2nd, 1914, an agreement between the Commission and the City of Ottawa was drawn up to conform to the revised agreement made during the preceding December with the Ottawa & Hull Power & Manufacturing Company. This agreement with the City of Ottawa, which supersedes all previous agreements, provides for the purchase of power at rates equivalent to those paid by the Commission to the Company, together with operating costs, interest on the capital investment made by the Commission, and payments to the reserve accounts. It is to remain in force for a period of ten years from the date of the first delivery of power under this agreement, and may be continued, at the option of the Corporation of the City of Ottawa, for one or two further consecutive terms of ten years each, all as **COPY** contained in fuller detail in Exhibit II of the Price, Waterhouse & Co. report previously mentioned.

Towards the end of the fiscal year 1917, the Hydro-Electric Power Commission of Ontario placed an order with the Ottawa & Hull Power & Manufacturing Company for three blocks of 500 horse-power each, in accordance with the terms of the contract of December 8th, 1913, thus bringing the total power taken to 6,500 horse-power. The additional power was required for the new pumping station of the City of Ottawa located at Lemieux Island. This was put into service on November 12th, 1917, and utilizes approximately 2,000 electrical horse-power. The commencement of operations of this pumping station brought about the cancellation of the contract of June, 1916, between the City of Ottawa and the Ottawa & Hull Power & Manufacturing Company for the temporary supply of 750 electrical horse-power to the old Queen Street pumping station, the use of which was discontinued.

During August of 1920 the Ottawa & Hull Power & Manufacturing Company put into operation their No. 2 power house, then recently completed, and shut down their No. 1 plant which had been supplying power to the Ottawa System. Plant No. 2 then took up the service without any interruption to the operation of the System. The Commission's new metering equipment, which in 1919 replaced the original instruments in use, was later moved from Plant No. 1 to Plant No. 2 and tested from time to time to insure accurate service.

The demand on the Ottawa System increased steadily, necessitating orders for additional blocks of power from time to time. The load during October, 1921, 9,098 horse-power, is an increase of about 1,500 horse-power over that in 1920. This was in excess of the amount officially ordered from the power company, and steps were at once taken to provide for further increases. In 1922 the peak demand was 11,394 horse-power, and the load early in 1923 was over 12,000 horse-power.

Rural System.

Consequent to applications for electricity made to the Commission, an agreement was entered into with the Municipal Corporation of the Township of Nepean on August 25th, 1921, under provisions of the Power Commission Act, "to provide for the supply of electrical energy or power to individual users". An Order-in-Council dated September 20th, 1921, authorized this contract, excerpts from which are contained in Exhibit III of the Price, Waterhouse & Co. report. The Order-in-Council of September 20th, 1921, also authorized the Commission to construct twelve miles of transmission lines to serve rural

districts. connection with rural lines to may be that we have not the correct

This was followed by Orders-in-Council under dates of November 29th, 1921, and June 23rd, 1922, granting the authority to further construct 6.61 miles and 6.50 miles of transmission lines, respectively.

The construction of rural lines on the Ottawa System was commenced in September, 1921. The first twelve miles were completed in February, 1922, and certain consumers in the Township of Nepean were then served with electrical energy. Six additional miles of rural lines were completed during October, 1922, all the rural lines serving a total of eighty-five rural consumers at that date. Since then application for electricity has been made by twenty-five other additional customers, and it is stated that the lines to supply these are now under construction.

The rural lines are being served with power from the Ottawa municipal distributing system. The power supplied is being metered by the City of Ottawa which is reimbursed to include the cost of operation, transformation and line losses at an agreed flat rate of \$21.00 per horse-power, thus showing operating and transfer costs of \$8.00 per horse-power in addition to the wholesale cost of power to the City of Ottawa which is now \$13.00 per horse-power. On June 29th, 1922, the Hydro-Electric Power Commission of Ontario authorized payments to the Corporation of the City of Ottawa for all power supplied to the rural lines of the Ottawa System at the above rate of \$21.00 per horse-power. This will evidently constitute the basis for charges to be made to the Township of Nepean, and should have added to it interest charges and such reserve rates as may pertain to the distribution of power to these rural districts.

In connection with rural lines it may be well to note that the Ontario Government has a special act known as the Rural Hydro-Electric Distribution Act, 1921, whereby it may provide up to one-half the capital necessary for primary rural lines under certain conditions. Section 4 of the Act reads as follows:

"Where power is supplied to a rural power district under the provisions of the Power Commission Act and amendments thereto there may be paid to the municipality or commission distributing the power in such rural power district under the recommendation of the Hydro-Electric Power Commission of Ontario, and the order of the Lieutenant-Governor in Council, a sum not exceeding fifty per cent. of the capital cost of constructing and erecting in the rural power zone primary transmission lines and cables required for the delivery of power in such rural power districts."

COPY

Description of the System.

General.

The Ottawa System lies north and east of the Rideau System. It now comprises that territory in the Province of Ontario within a radius of about ten miles from the City of Ottawa and includes within its boundaries part of the County of Carleton. At the present time the rural lines extend to Bell Corner and Merivale to the south and west of the City of Ottawa.

The map included as a frontispiece shows the whole of the transmission systems of the Hydro-Electric Power Commission of Ontario with the location of generating stations, high voltage transformer stations, high voltage transmission lines, and low voltage transformer stations clearly indicated, and shows the various systems in their relation to one another. The tinted portion

It is requested that you will be good enough to send me a copy of the report of the committee on the subject of the proposed amendment to the charter of the New York Stock Exchange, and also a copy of the report of the committee on the subject of the proposed amendment to the charter of the New York Stock Exchange, and also a copy of the report of the committee on the subject of the proposed amendment to the charter of the New York Stock Exchange.

Very respectfully,
J. P. Morgan

The enclosed is a copy of a letter from the New York Stock Exchange, dated the 10th inst., and is a copy of the report of the committee on the subject of the proposed amendment to the charter of the New York Stock Exchange, and also a copy of the report of the committee on the subject of the proposed amendment to the charter of the New York Stock Exchange, and also a copy of the report of the committee on the subject of the proposed amendment to the charter of the New York Stock Exchange.

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Enclosure of 1st class

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The enclosed is a copy of a letter from the New York Stock Exchange, dated the 10th inst., and is a copy of the report of the committee on the subject of the proposed amendment to the charter of the New York Stock Exchange, and also a copy of the report of the committee on the subject of the proposed amendment to the charter of the New York Stock Exchange, and also a copy of the report of the committee on the subject of the proposed amendment to the charter of the New York Stock Exchange.

of the map indicates the Ottawa System.

The map included as page 11 shows the Ottawa System on a larger scale than the frontispiece and also gives the names of the principal centres concerned. It also shows the Rideau System which is adjacent to the Ottawa System, and the St. Lawrence System to the southeast of it, both of which at some time may be inter-connected with the Ottawa System.

Speaking broadly, the Ottawa System consists of a distributing system supplied by a large privately-owned generating station which serves the City of Ottawa through underground cables, and some rural lines served from the municipal distributing system of the City of Ottawa.

COPY

Generating Stations and Other Sources of Power Supply.

(a) Ottawa & Hull Power & Manufacturing Company, Limited.

The entire power supply for the Ottawa System is purchased from the Ottawa & Hull Power & Manufacturing Company which owns two plants on the Ottawa River at Chaudiere Falls known respectively as Plant No. 1 and Plant No. 2. The water supply for both plants is led from an arch dam about 22 feet high equipped with concrete piers and wooden stop-logs. This dam is located on the Ottawa River between Ottawa and Hull and is also utilized by the Ottawa Light, Heat & Power Company, as well as by a number of other industries. Plant No. 1, installed in 1902, is situated on Philemon Island above Bridge Street, Hull, Quebec. The water is led through a short concrete head-race to a power house measuring about 90 feet by 180 feet, which contains the following equipment. The initial installation consisted of

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When the Commission was first given the name of the President's Council on Economic Policy, it was a body of 12 members, 6 appointed by the President and 6 by the Senate. The Commission was created by Executive Order on July 1, 1962, and its first meeting was held on July 1, 1962. The Commission was created to advise the President on economic policy and to coordinate the economic policy of the Executive branch of the Government. The Commission was created to advise the President on economic policy and to coordinate the economic policy of the Executive branch of the Government.

... ..

It is hereby agreed that the transmission and the receipt of the enclosed are not confidential.

... ..

THESE RESULTS ARE IN ACCORDANCE WITH THE FINDINGS OF OTHER STUDIES.

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• *Journal of Management Education* 31(10):1039-1052

THESE RESULTS WERE OBTAINED BY THE USE OF THE FOLLOWING EQUATION:

Original & still under a 100% interest rate. The price is \$100.00.

Official Report of the Commission of the European Communities, 1991, p. 10.

ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED DATE 08-11-2010 BY 60322 UCBAW

THESE RESULTS WERE OBTAINED BY THE USE OF THE FOLLOWING DATA:

Approved by the United States District Court for the District of Columbia

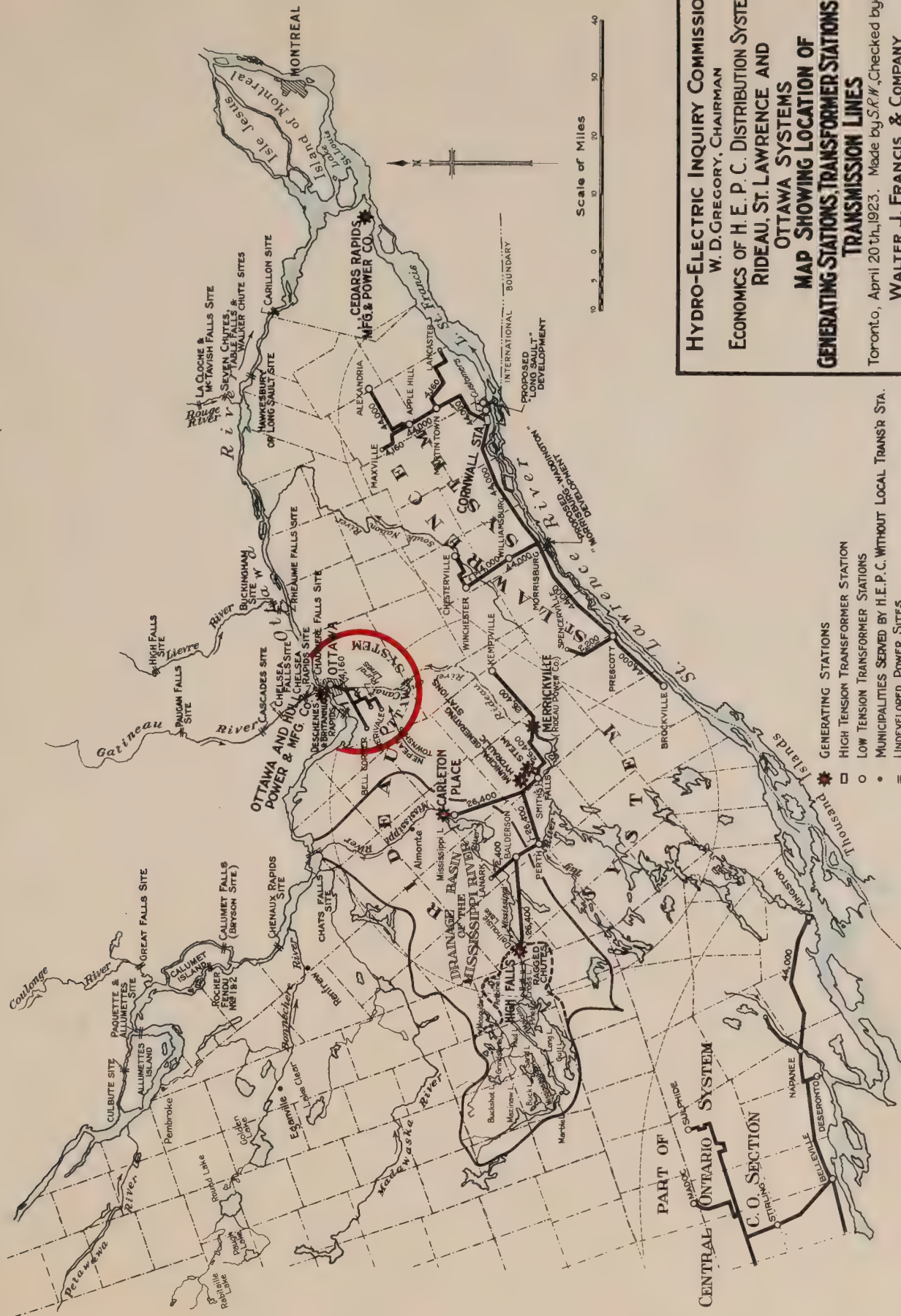
The House will be in session at 10:30 a.m. on Monday, May 10, 1960.

100-443888-100

— 1980. *Flora of Ecuador*. Vol. 1. *Monocotyledons*. (Edinburgh: Royal Botanic Garden).

Journal of Interpersonal Violence 26(10) 1978-1994
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12. *Admission to the University of the Pacific*



HYDRO-ELECTRIC INQUIRY COMMISSION
W. D. GREGORY, CHAIRMAN
ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS
RIDEAU, ST. LAWRENCE AND
OTTAWA SYSTEMS
**MAP SHOWING LOCATION OF
GENERATING STATIONS, TRANSFORMER STATIONS AND
TRANSMISSION LINES**

Toronto, April 20th, 1923. Made by S.R.W., Checked by W.L.F.
WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS

- GENERATING STATIONS
* HIGH TENSION TRANSFORMER STATION
□ LOW TENSION TRANSFORMER STATIONS
• MUNICIPALITIES SERVED BY H.E.P.C. WITHOUT LOCAL TRANS. STA.
= UNDEVELOPED POWER SITES
TRANSMISSION LINE VOLTAGE SHOWN THUS 44,000

three Dayton Globe horizontal turbines each of 2,500 horse-power capacity, which are directly connected to three Canadian General Electric 1,500-K. W., 2-phase, 60-cycle, 2,200-volt generators. Six 1,000-kilowatt station transformers step up the energy of these generators to 3 phase, 60 cycles, 11,000 volts. In 1909 there were added two 3,500 horse-power turbines constructed by William Kennedy & Sons, each of which was directly connected to a 2,000-kilowatt, 3-phase, 60-cycle, 11,000-volt generator, made by the Canadian General Electric Company. These units operate at a mean net head of 32 feet. It is understood that the regular operation of this plant was modified soon after the Ottawa & Hull Power & Manufacturing Company completed their new plant, No. 2, and that it has since then been maintained as a stand-by and as an additional source of power during certain periods.

Plant No. 2, put into operation during August of 1920, gets its water from the dam through a concrete head-race 300 feet wide and 430 feet long, and is situated adjacent to Plant No. 1. The power house is of concrete and is about 200 feet long by 200 feet wide, and also utilizes a mean net head of 32 feet.

This plant is designed for an ultimate installation of four 7,500 horse-power turbines. The installed equipment at the present time consists of one J. M. Voith 7,500 horse-power horizontal turbine and one Boving 7,500 horse-power horizontal turbine. These are directly connected to two 6,750-K.V.A., 3-phase, 60-cycle, 2,300-volt generators made by the Canadian General Electric Company. The voltage is raised to 11,000 volts by means of individual Delta-Y banks of transformers directly connected to the generators. The

two present units operate regularly at about 25 per cent. over their normal rating. It is stated that one additional unit of the same size has been ordered and will be put into Plant No. 2 during the autumn of 1923.

The power supply to the Commission is measured by the Company's meters and checked by the Commission's meters installed in the power house of Plant No. 2, and it is then transmitted to the distributing station of the City of Ottawa through underground cables at 11,000 volts. The Ottawa & Hull Power & Manufacturing Company also sells large blocks of power to the Ottawa Light, Heat & Power Company, to the Hull Electric Company, and to a large number of important industries located in the district of the City of Ottawa.

The Ottawa & Hull Power & Manufacturing Company is said to be contemplating the development of 30,000 or 40,000 horse-power in 1923 or 1924 at Bryson, Quebec, on the Ottawa River at Calumet Island.

(b) Undeveloped Power Sites, Ottawa System.

There are numerous undeveloped power sites within easy transmission distance of the Ottawa and the Rideau Systems, that include land and water rights both in the Provinces of Quebec and Ontario or in Quebec alone. The more important of these are listed in the following table which also gives the names of the rivers, the distance from Ottawa, the head, the approximate future horse-power available, as well as the owners, where this information is available. It will be noted in the table that the distances are given in miles in a straight line from Ottawa. The actual transmission distance from the site to Ottawa would be slightly greater in most cases in order to take advantage of

ordered and will be put into Field No. 2 during the autumn of 1933.

The power supply to the Commission is managed by the Ontario's Electric
and is shared by the Commission's power facilities in the power house at
the site of the Commission in the immediate vicinity of the site of
the power house at the site of the Commission. The power house at the
site of the Commission is managed by the Ontario's Electric
and is shared by the Commission's power facilities in the power house at
the site of the Commission in the immediate vicinity of the site of
the power house at the site of the Commission.

CONFIDENTIAL

The above information was obtained from the records of the Department of the Interior, Bureau of Land Management, and is being furnished to you for your information.

local conditions, and to follow easily patrolled routes, but the actual distances would not be materially greater than those of the table. The table of horse-power is estimated by using the possible future regulated flow of the various rivers named. Under present conditions the power would be somewhat less than the figures of the table, but the horse-power given should be realized by developing a reasonable amount of storage on each of the water-sheds.

Table of Large Undeveloped Power Sites - Ottawa District

River	Name of Site	Direct Distance from Ottawa Head	Future Commercial Capacity with Fully Regulated River	Owner and Remarks
		Miles Feet		
Ottawa	Allumette & Paquette Rapids	73 20	34,000	
Ottawa	Calumet (Bryson)	50 56	40,000	Suggested partial development by Ottawa & Hull Power & Manufacturing Co.
Ottawa	Rocher Fendu 1 & 2	54 70	102,000	
Ottawa	Chenau	40 35	90,000	
Ottawa	Chats Falls	30 50	150,000	H.E.P.C. of Ontario and various interests, including Robertson Estate.
Ottawa	Deschenes & Britannia	5 20	63,000	Partially developed by Hull Electric Company.
Ottawa	Long Sault (Hawkesbury)	53 19	94,000	2,000 H.P. developed by Hawkesbury Lumber Co.
Ottawa	Carillon	65 47	200,000	Under option to Quebec N.E.H.E. Commission.
Gatineau	Chelsea Rapids	4 60	50,000	Gilmour & Hughson and
Gatineau	Chelsea Falls	5 80	80,000	Riordon P. & P. Company.
Gatineau	Cascades	14 25	25,000	F. T. Cross.
Gatineau	Paugan Falls	30 120	130,000	Hull Electric Company, plant being designed.

Table of Large Undeveloped Power Sites - Ottawa District (continued)

River	Name of Site	Direct Distance	Approx. Head	Future Commercial Capacity with Fully Regulated River	Owner and Remarks
		From Ottawa - Miles			
Lievre	Rheauame Falls	16	200	50,000)	McLaren interests, 8,500 horse-power developed at Buckingham utilizing 65 feet head.
Lievre	Buckingham	16	100	25,000)	
Lievre	High Falls	38	180	40,000)	
Rouge	Seven Chute, Table Falls and Walker Chute	53	150	20,000	
Rouge	La Cloche and McTavish	65	50	7,000	1,500 horse-power partial development at Table Falls.
Coulange	Great Falls	68	100	10,000	

COPY

These sites aggregating over one million horse-power are all a possible source of power supply for the Provinces of Ontario and Quebec, the most distant being about 75 miles from the City of Ottawa. They will be referred to again in the section entitled "Growth of Market and Ultimate Sources of Power Supply". There is also a large number of smaller powers in the district which are not included in the table.

Miscellaneous Power Plants in the District.

There are several hydro-electric developments of magnitude in the district of the Ottawa System besides the plants of the Ottawa & Hull Power & Manufacturing Company. Most of these are used to supply electrical energy to the various industries which operate them, but the plants of the Ottawa Light, Heat & Power Company and of the Hull Electric Company are for public

TABLE 1. SUMMARY OF DATA FOR THE YEAR 1964

Plant	Type	Capacity (MW)	Output (MWh)	Cost (\$/MWh)	Efficiency (%)	Notes
1	Coal	1,200	10,000	10.0	35	Operating since 1960
2	Coal	800	7,000	12.5	32	Operating since 1961
3	Coal	600	5,000	15.0	30	Operating since 1962
4	Coal	400	3,000	18.0	28	Operating since 1963
5	Coal	200	1,500	22.0	25	Operating since 1964
6	Coal	100	750	25.0	22	Operating since 1965
7	Coal	50	375	30.0	20	Operating since 1966
8	Coal	25	187.5	35.0	18	Operating since 1967
9	Coal	12.5	93.75	40.0	15	Operating since 1968
10	Coal	6.25	46.875	45.0	12	Operating since 1969
11	Coal	3.125	23.4375	50.0	10	Operating since 1970
12	Coal	1.5625	11.71875	55.0	8	Operating since 1971
13	Coal	0.78125	5.859375	60.0	5	Operating since 1972
14	Coal	0.390625	2.9296875	65.0	3	Operating since 1973
15	Coal	0.1953125	1.46484375	70.0	2	Operating since 1974
16	Coal	0.09765625	0.732421875	75.0	1	Operating since 1975
17	Coal	0.048828125	0.3662109375	80.0	0.5	Operating since 1976
18	Coal	0.0244140625	0.18310546875	85.0	0.2	Operating since 1977
19	Coal	0.01220703125	0.091552734375	90.0	0.1	Operating since 1978
20	Coal	0.006103515625	0.0457763671875	95.0	0.05	Operating since 1979
21	Coal	0.0030517578125	0.02288818359375	100.0	0.02	Operating since 1980
22	Coal	0.00152587890625	0.011444091796875	105.0	0.01	Operating since 1981
23	Coal	0.000762939453125	0.0057220458984375	110.0	0.005	Operating since 1982
24	Coal	0.0003814697265625	0.00286102294921875	115.0	0.002	Operating since 1983
25	Coal	0.00019073486328125	0.001430511474609375	120.0	0.001	Operating since 1984
26	Coal	0.000095367431640625	0.0007152557373046875	125.0	0.0005	Operating since 1985
27	Coal	0.0000476837158203125	0.00035762786865234375	130.0	0.0002	Operating since 1986
28	Coal	0.00002384185791015625	0.000178813934326171875	135.0	0.0001	Operating since 1987
29	Coal	0.000011920928955078125	0.0000894069671630859375	140.0	0.00005	Operating since 1988
30	Coal	0.0000059604644775390625	0.00004470348358154296875	145.0	0.00002	Operating since 1989
31	Coal	0.00000298023223876953125	0.000022351741790771484375	150.0	0.00001	Operating since 1990
32	Coal	0.000001490116119384765625	0.0000111758708953857421875	155.0	0.000005	Operating since 1991
33	Coal	0.0000007450580596923828125	0.00000558793544769287109375	160.0	0.000002	Operating since 1992
34	Coal	0.00000037252902984619140625	0.000002793967723846435546875	165.0	0.000001	Operating since 1993
35	Coal	0.000000186264514923095703125	0.0000013969838619232177734375	170.0	0.0000005	Operating since 1994
36	Coal	0.0000000931322574615478515625	0.00000069849193096160888671875	175.0	0.0000002	Operating since 1995
37	Coal	0.00000004656612873077392578125	0.000000349245965480804443359375	180.0	0.0000001	Operating since 1996
38	Coal	0.000000023283064365386962890625	0.0000001746229827404022216796875	185.0	0.00000005	Operating since 1997
39	Coal	0.0000000116415321826934814453125	0.00000008731149137020111083984375	190.0	0.00000002	Operating since 1998
40	Coal	0.00000000582076609134674072265625	0.000000043655745685100555419921875	195.0	0.00000001	Operating since 1999
41	Coal	0.000000002910383045673370361328125	0.0000000218278728425502777099609375	200.0	0.000000005	Operating since 2000
42	Coal	0.0000000014551915228366851806640625	0.00000001091393642127513885498046875	205.0	0.000000002	Operating since 2001
43	Coal	0.00000000072759576141834259033203125	0.000000005456968210637569427490234375	210.0	0.000000001	Operating since 2002
44	Coal	0.000000000363797880709171295166015625	0.0000000027284841053187847137451171875	215.0	0.0000000005	Operating since 2003
45	Coal	0.0000000001818989403545856475830078125	0.00000000136424205265939235687255859375	220.0	0.0000000002	Operating since 2004
46	Coal	0.00000000009094947017729282379150390625	0.000000000682121026329696178436279296875	225.0	0.0000000001	Operating since 2005
47	Coal	0.000000000045474735088646411895751953125	0.0000000003410605131648480892181396484375	230.0	0.00000000005	Operating since 2006
48	Coal	0.0000000000227373675443232059478759765625	0.00000000017053025658242404460906982421875	235.0	0.00000000002	Operating since 2007
49	Coal	0.00000000001136868377216160297393798828125	0.000000000085265128291212022304534912109375	240.0	0.00000000001	Operating since 2008
50	Coal	0.000000000005684341886080801486968994140625	0.0000000000426325641456060111522674560546875	245.0	0.000000000005	Operating since 2009
51	Coal	0.0000000000028421709430404007434844970703125	0.00000000002131628207280300557613372802734375	250.0	0.000000000002	Operating since 2010
52	Coal	0.00000000000142108547152020037174224853515625	0.000000000010658141036401502788066864013671875	255.0	0.000000000001	Operating since 2011
53	Coal	0.000000000000710542735760100185871124267578125	0.0000000000053290705182007513940334320068359375	260.0	0.0000000000005	Operating since 2012
54	Coal	0.0000000000003552713678800500929355621337890625	0.00000000000266453525910037569701671600341796875	265.0	0.0000000000002	Operating since 2013
55	Coal	0.00000000000017763568394002504646778106689453125	0.000000000001332267629550187798508358001708984375	270.0	0.0000000000001	Operating since 2014
56	Coal	0.000000000000088817841970012523233890533447265625	0.0000000000006661338147750938992541790008544921875	275.0	0.00000000000005	Operating since 2015
57	Coal	0.0000000000000444089209850062616169452667236328125	0.00000000000033306690738754694962708950042724609375	280.0	0.00000000000002	Operating since 2016
58	Coal	0.00000000000002220446049250313080847263336181640625	0.000000000000166533453693773474813544750213623046875	285.0	0.00000000000001	Operating since 2017
59	Coal	0.000000000000011102230246251565404236316680908203125	0.0000000000000832667268468867374067723751068115234375	290.0	0.000000000000005	Operating since 2018
60	Coal	0.0000000000000055511151231257827021181583404541015625	0.00000000000004163336342344336870338618755340576171875	295.0	0.000000000000002	Operating since 2019
61	Coal	0.00000000000000277555756156289135105907917022705078125	0.000000000000020816681711721684351693093776672880859375	300.0	0.000000000000001	Operating since 2020
62	Coal	0.0000000000000013877787807814456755295395851135265625	0.0000000000000104083408558608421758465468883364404296875	305.0	0.0000000000000005	Operating since 2021
63	Coal	0.00000000000000069388939039072283776476979255676328125	0.00000000000000520417042793042108792327344416682221484375	310.0	0.0000000000000002	Operating since 2022
64	Coal	0.000000000000000346944695195361418882384896278381640625	0.000000000000002602085213965210543961636722083411107421875	315.0	0.0000000000000001	Operating since 2023
65	Coal	0.0000000000000001734723475976807094411924481391908203125	0.0000000000000013010426069826052719808183610417055537109375	320.0	0.00000000000000005	Operating since 2024
66	Coal	0.00000000000000008673617379884035472059622406959541015625	0.00000000000000065052130349130263599040918052085277685546875	325.0	0.00000000000000002	Operating since 2025
67	Coal	0.000000000000000043368086899420177360298112034797705078125	0.000000000000000325260651745651317995204590260426388427734375	330.0	0.00000000000000001	Operating since 2026
68	Coal	0.00000000000000002168404344971008868014905601739885265625	0.0000000000000001626303258728256589976022951302131942140625	335.0	0.000000000000000005	Operating since 2027
69	Coal	0.000000000000000010842021724855044340074528008699426328125	0.0000000000000000813151629364128294988011475651065971071875	340.0	0.000000000000000002	Operating since 2028
70	Coal	0.0000000000000000054210108624275221700372640043497131640625	0.000000000000000040657581468206414749400573782553298537109375	345.0	0.000000000000000001	Operating since 2029
71	Coal	0.00000000000000000271050543121376108501863200217485658203125	0.0000000000000000203287907341032073747002868912766492685546875	350.0	0.0000000000000000005	Operating since 2030
72	Coal	0.000000000000000001355252715606880542509316001087428291015625	0.0000000000000000101643953670516036873501434456383246342734375	355.0	0.0000000000000000002	Operating since 2031
73	Coal	0.000000000000000000677626357803440271254658000543714145625	0.000000000000000005082197683525801843675071722819162317140625	360.0	0.0000000000000000001	Operating since 2032
74	Coal	0.0000000000000000003388131789017201356273290002718570728125	0.000000000000000002541098841762900921837503561409581158571875	365.0	0.00000000000000000005	Operating since 2033
75	Coal	0.00000000000000000016940658945086006781366450013592853640625	0.0000000000000000012705494208814504609187517807047905792859375	370.0	0.00000000000000000002	Operating since 2034
76	Coal	0.000000000000000000084703294725430033906832250067964268203125	0.00000000000000000063527471044072523045937589035239528964296875	375.0	0.00000000000000000001	Operating since 2035
77	Coal	0.0000000000000000000423516473627150169534161250339821341015625	0.000000000000000000317637355220362615229687945176197644821484375	380.0	0.000000000000000000005	Operating since 2036
78	Coal	0.00000000000000000002117582368135750847670806251699106705078125	0.0000000000000000001588186776101813076148439725880988224107421875	385.0	0.000000000000000000002	Operating since 2037
79	Coal	0.000000000000000000010587911840678754238354031258495533525390625	0.00000000000000000007940933880509065380742198629404941120537109375	390.0	0.000000000000000000001	Operating since 2038
80	Coal	0.0000000000000000000052939559203393771191770156254247766761953125	0.000000000000000000039704669402545326903710993147024705602685546875	395.0	0.0000000000000000000005	Operating since 2039
81	Coal	0.0000000000000000000026469779601696885595885078125212388338096875	0.000000000000000000019852334701272663451855496573512352801342734375	400.0	0.0000000000000000000002	Operating since 2040
82	Coal	0.00000000000000000000132348898008484427797925390625106194169046875	0.00000000000000000000992616735063633172592774828675617640067140625	405.0	0.0000000000000000000001	Operating since 2041
83	Coal	0.000000000000000000000661744490042422138989626953125053097095234375	0.00000000000000000000496308367531816586296387414337808820033571875	410.0	0.00000000000000000000005	Operating since 2042
84	Coal	0.000000000000000000000330872245021211069494813476562502654847619375	0.00000000000000000000248154183765908293148193707168904410016784375	415.0	0.00000000000000000000002	Operating since 2043
85	Coal	0.0000000000000000000001654361225106055347474067382812501327243096875	0.000000000000000000001240770918829541465740968535844522050083921875	420.0	0.00000000000000000000001	Operating since 2044
86	Coal	0.00000000000000000000008271806125530276737370336914062500663615484375	0.0000000000000000000006203854594147707328720942679222610250419609375	425.0	0.000000000000000000000005	Operating since 2045
87	Coal	0.00000000000000000000004135903062765138368685168457031250033				

utility use.

As the power situation in the district is affected by the keen competition of these plants, a brief description of them is appended.

The main competitor of the Hydro-Electric Power Commission in the district included as the Ottawa System is the Ottawa Light, Heat & Power Company, which owns three hydro-electric plants on the Ottawa River and one auxiliary steam plant, and distributes power in the City of Ottawa and vicinity in competition with the Corporation of the City of Ottawa. The suburban area served by the Company includes Eastview, Britannia, part of Nepean Township, Gloucester Township and Westboro. Some power is also distributed to Hull and a block of power is sold to the Municipality of Gatineau Point and to the Ottawa Electric Railway Company.

Plant No. 1 of the Ottawa Light, Heat & Power Company, Limited, is situated on Head Street, Ottawa. The water is led from the dam at Chaudiere Falls to the power house through an open wooden flume having a cross sectional area of 400 square feet. The first installation of this plant was made in 1901, and an addition was made in 1909. The installation at the present time consists of three Stillwell-Eierce and one Dayton-Globe horizontal turbines, each of 900 horse-power capacity and directly connected to four Westinghouse 700-kilowatt, 2-phase, 60-cycle, 2,200-volt generators. These units utilize a mean net head of 28 feet.

Plant No. 2, was originally the plant of the Standard Electric Company installed in 1891. It was remodelled in 1910, operating at that time with

two units, and in 1914 a third unit was added. An old timber slide channel conveys the water to the power house situated on Amelia Island, below Bridge Street, Ottawa, and makes available a mean net head of 33 feet. The installed capacity at the present time is 5,100 horse-power, made up of three S. Morgan Smith 1,700 horse-power horizontal turbines directly connected to three Westinghouse 1,300-kilowatt, 2-phase, 60-cycle, 2,300-volt generators.

Plant No. 3, located on Montreal Street, Ottawa, is the auxiliary steam plant of the Ottawa Light, Heat & Power Company, installed in 1905. The equipment consists of four 400 horse-power Babcock & Wilcox boilers, and three 800 horse-power boilers of the same make; two steam turbines, one of 2,000 and one of 4,300 horse-power, making a total capacity of 6,300 horse-power; and two Westinghouse 2-phase, 60-cycle, 2,200-volt generators, one of 1,500 kilowatts capacity and the other of 3,200 kilowatts capacity, or a total of 4,700 kilowatts. This station has installed three banks of two transformers each which step up the voltage to 12,000 volts.

Plant No. 4 of the Ottawa Light, Heat & Power Company was installed with one unit in 1899 by the Ottawa Power Company. A second unit was added in 1900, making a total capacity of 4,000 horse-power. It is also located at Chaudiere Falls on the Ottawa River, the power house being on Middle Street just below Bridge Street, Ottawa. Two Sanson-Leffel 2,000 horse-power horizontal turbines operating at a mean net head of 29.5 feet are directly connected to two Canadian General Electric 2-phase, 60-cycle, 2,300-volt, 1,875-K.V.A. generators.

The Hull Electric Company of Hull, Quebec, also generates a surplus

1. The first of the three is a small, dark, round object, about the size of a pea, and is found in the same place as the other two. It is also found in the same place as the other two.

THE STATE OF TEXAS, COUNTY OF DALLAS, ss. I, _____, Clerk of the County Court, do hereby certify that the foregoing is a true and correct copy of the original as the same appears from the records of the County Court of Dallas County, Texas.

supply of electricity in addition to the requirements of its traction utility operating between Ottawa, Hull and Aylmer, and it sells electrical energy to various classes of consumers in the district of Hull and Aylmer.

The two present generating stations of the Hull Electric Company are located on the Quebec side of the Ottawa River at Deschenes Rapids, and operate under 9 feet head. One plant was installed in 1896, and the other about 1900. In the older power house is a set of six William Kennedy & Sons, 60-inch, 175 horse-power turbines operating a line shaft to which are belted two 150-kilowatt, monocyclic, 2,300-volt, A. C. generators, and two 300-kilowatt, 600-volt, D. C. generators. In the other plant are two sets of five and six 61-inch, Trump turbines, brown geared to two line shafts, the shafts being placed at right angles to one another. Each shaft is direct-connected to one 800-kilowatt, 3-phase, 60-cycle, 2,500-volt generator. The total capacity of the plants is 1,900 kilowatts alternating current and 600 kilowatts direct current.

The Hull Electric Company is said to be now seriously considering the early development of the site owned by the Company at Pagan Falls on the Gatineau River about thirty miles from Ottawa for an ultimate capacity of 125,000 horse-power or more.

There is also a small municipally-owned plant which was installed in 1917 on a branch of the Ottawa River in Hull, containing one 1,100 horse-power turbine operating under 19 feet head, and direct-connected to a 750-K.V.A., 2-phase, 60-cycle, 2,200-volt generator. This plant is used for street lighting in Hull.

Transmission Lines.

Up to October 15th, 1922, the Hydro-Electric Power Commission of Ontario had constructed a total of eighteen miles of low voltage transmission lines forming a 4,160-volt network, supplying the rural districts in the Township of Nepean.

There are no high voltage transmission lines in the Ottawa System that are owned by the Commission. The Corporation of the City of Ottawa gets its power supply at 11,000 volts delivered through the high voltage transmission lines of the Ottawa & Hull Power & Manufacturing Company to the Ottawa city limits, at Chaudiere Bridge, from where it is taken to the Ottawa substation at the same voltage by means of underground cables which form part of the city's electrical distributing system.

Transforming and Distributing Stations.

The Commission does not own any transforming substations on the Ottawa System. The City of Ottawa steps down its power for municipal distribution by means of its own transforming equipment, and also steps down the power for transmission to the rural district for which it receives remuneration as already noted at the rate of about \$6.00 per horse-power in addition to the price billed to the city for power supply.

Local Distributing Systems.

With the exception of the rural lines already mentioned, the Hydro-Electric Power Commission does not distribute retail power to consumers on the Ottawa System. The Commission acts as a wholesale distributor only, and in the City of Ottawa the electricity is distributed by a local Commission appointed solely

for that purpose. It is understood that the accounting for this city is done in accordance with the standard accounting system of the Hydro-Electric Power Commission and the details are given in the Annual Reports.

Characteristics of Market.

Population Served and Percentage of Consumers to Population.

The district served by the Ottawa System is both urban and rural, nearly all of the load being in the City of Ottawa.

"Municipal Statistics" of the Province of Ontario for 1921, gives a total population of about 146,000 for that portion of Carleton County which is tributary to the Ottawa System. At December 31st, 1921, the total population in the City of Ottawa was 110,708, with 11,532 consumers served by the local municipal commission.

The Ottawa Light, Heat & Power Company serves the rest of the consumers in that city, and is also the sole distributor of power in the town of Eastview and in the district between Britannia and Ottawa. From the total of about 35,000 population for the suburban territory included as the Ottawa System, about 10,000 might be deducted as the population served by the Ottawa Light, Heat & Power Company. During 1922 the Hydro-Electric Power Commission of Ontario had constructed about eighteen miles of rural lines in the Township of Nepean, thus serving a rural population of about 3,000 or 4,000, the number of consumers being about eighty-five at October, 1922, and the remaining tributary population of about 20,000 or 22,000 can only be supplied by a fairly

extensive system of rural lines.

The Corporation of the City of Ottawa was billed with 7,654 horse-power in the fiscal year 1921. In 1922 the total power billed to the System was 9,135.7 horse-power, of which an amount of about 25 horse-power was taken at the end of 1922 by the rural customers in Nepean Township. Judging by the steady increase in the number of consumers taking power from the municipal distributing system in the City of Ottawa each year, it is expected that the increase during 1923 will be about 600 consumers of all classes taking about 1,000 horse-power. This growth can be accounted for by the fact that the Corporation of the City of Ottawa sells power to consumers at a somewhat lower rate than its competitor, the Ottawa Light, Heat & Power Company.

The following table gives in detail the number of consumers at the end of the fiscal year 1921 in the City of Ottawa, the only place served by the Commission. It also gives the approximate horse-power billed in 1921, and the average horse-power per consumer in 1921. The figures are useful for comparison with other systems, although they should be used with caution. No figures for kilowatt-hours consumed are available.

Table of Market Statistics - City of Ottawa

Population	110,708
Number of Consumers	11,532
Percentage of Consumers to Population	10.5
Horse-power Billed in 1921	7,654
Billed Horse-power per Consumer	0.66
Billed Horse-power per Capita	0.06

THE CHICAGO BOARD OF TRADE

REPORT OF THE CHICAGO BOARD OF TRADE

FOR THE YEAR 1911

CHICAGO, ILL., JANUARY 1, 1912

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FOR THE YEAR 1911

CHICAGO, ILL., JANUARY 1, 1912

Growth of Market and Ultimate Sources of Power Supply.

Since the commencement of operations of the Ottawa System in 1907, the growth of the demand of the Ottawa Municipal system has been fairly rapid. It has increased from about 1,200 horse-power in 1907, to an average of about 9,100 horse-power in 1922, with a maximum peak of about 11,400 horse-power during that year. The following table shows the growth of the population of the City of Ottawa, and the number of consumers taking the Commission's power from 1913 to 1921 inclusive:

Table of Population and Number of Consumers - City of Ottawa

Year	Total Number of Consumers	Population
1913	6,736	100,180
1914	7,350	100,180
1915	8,538	101,785
1916	9,207	100,163
1917	10,007	100,300 +
1918	10,436	100,561
1919	10,393	107,732
1920	10,939	107,732
1921	11,532	110,708

The problem of serving rural customers is difficult, the average number of consumers per mile of transmission line being small. The experience of the Hydro-Electric Power Commission of Ontario up to the present time indicates that only three or four consumers per mile, on the average, are obtainable. At October 31st, 1922, the number of consumers served by the Commission in the rural districts of the Ottawa System averaged 4.7 per mile of line.

TABLE 1. Summary of results of the study.

The following table summarizes the results of the study. The data are presented in the form of a table with three columns: Year, Total, and Percent of Total. The data are presented for the years 1961 through 1965. The total number of cases is 1,000. The percent of total for each year is as follows: 1961, 100%; 1962, 100%; 1963, 100%; 1964, 100%; 1965, 100%.

From 1961 to 1965 inclusive

TABLE 1. Summary of results of the study.

Year	Total	Percent of Total
1961	1,000	100%
1962	1,000	100%
1963	1,000	100%
1964	1,000	100%
1965	1,000	100%

COPY

The problem of serving rural consumers is difficult, the various number of consumers are small and scattered over wide areas. The consumers are often in remote areas, and the service is often difficult to provide. The consumers are often in remote areas, and the service is often difficult to provide. The consumers are often in remote areas, and the service is often difficult to provide.

The situation at the present time is that the Ottawa System can purchase an abundant power supply at a very favourable price, thus enabling the City of Ottawa to sell electricity for lighting and other purposes at lower rates than those in most Canadian cities. That the people are satisfied with the service rendered by the municipal distributing system is self evident from the fact that each year since its inception the number of consumers and the demand for power have increased. The domestic power market in the City of Ottawa at the present time has been well covered, and unless the city grows rapidly a large increase in the load of the Commission can only take place by further accretions of consumers from the privately-owned company and by the increased use of current per capita. Both of these factors are evidently influencing the growth. On the other hand, the indications are that there is likely to be a large demand for power for pulp and paper developments, for smelting, and for general manufacturing purposes, provided large blocks of power could be made available in the Ottawa district. The development of one or two of the sites previously mentioned, which it is anticipated will be carried out in the very near future, will provide ample capacity to supply the demands for electricity of the Ottawa System and district for a long time to come. If the Ottawa and Rideau Systems be extended southwards and eastwards and the St. Lawrence System be extended northwards, it is possible that in the future inter-connecting lines may be constructed so that any of these Systems might receive power from the water powers of the Ottawa and Gatineau Rivers, or from the water powers of the St. Lawrence River if these be developed. Because of the networks of high voltage transmission lines now

[illegible]

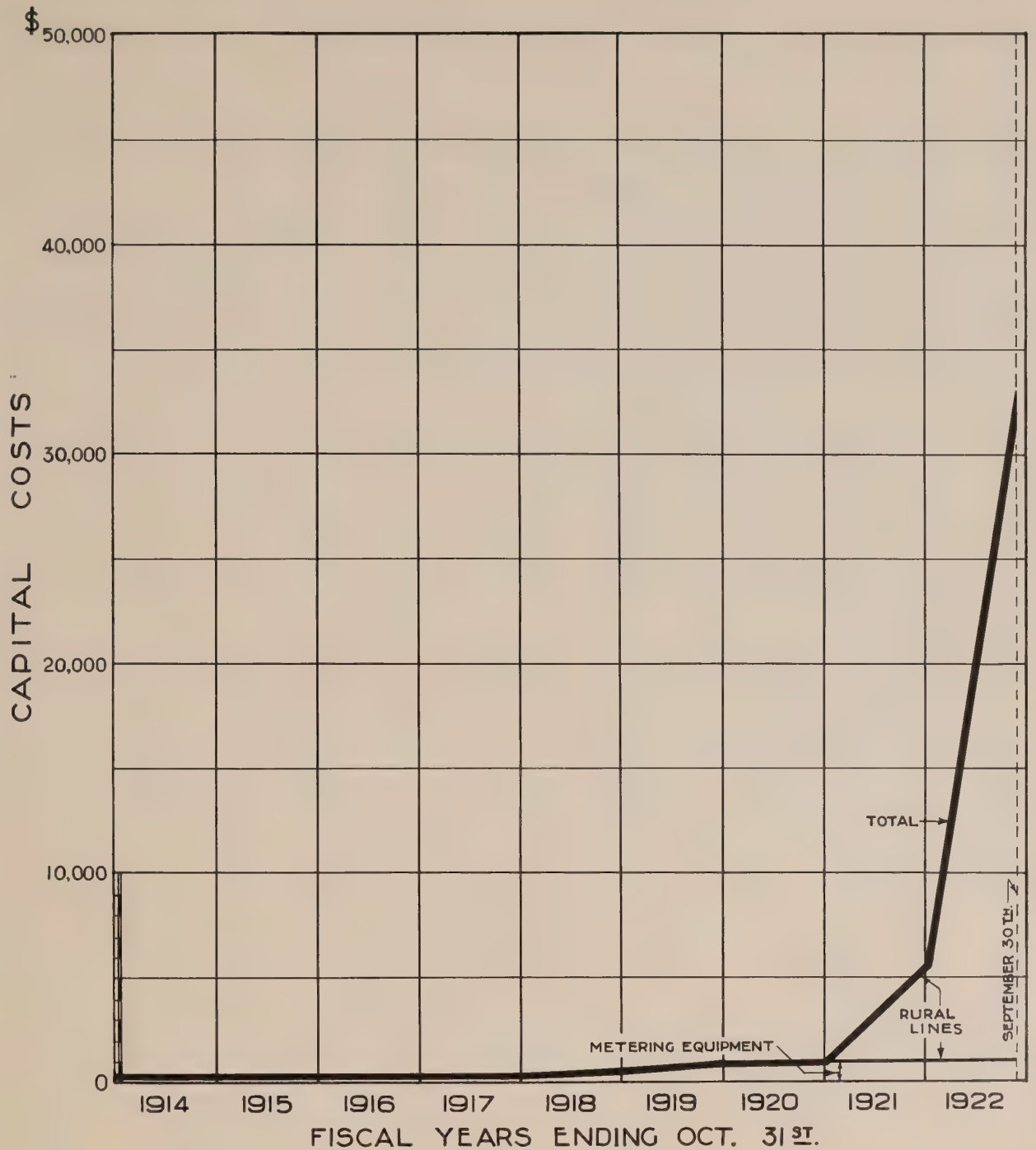
in existence, the Commission could purchase large blocks of power under whole-sale conditions from the privately-owned plants mentioned above, and should be enabled to successfully compete with other distributors of power in the districts of these Systems. It would appear feasible that agreements could be made with large private producers of power to prevent duplication of transmission lines in the districts served by the Commission and thus permit the Hydro-Electric Power Commission of Ontario to serve the whole of the eastern portion of Ontario without competition.

CAPITAL

Capital Costs.General.

The capital costs of the Ottawa System have been almost negligible until the construction of rural lines was commenced. Up to the end of the fiscal year 1920, certain meters located in the Ottawa & Hull Power & Manufacturing Company's plant were the only equipment owned by the Commission. The figures of capital costs given in the following table and plotted diagrammatically on the sheet of curves included as page 25 were obtained from the Annual Reports of the Hydro-Electric Power Commission, and conform with the figures given on page 7 of the "Report on Investigation of Accounts of Ottawa System" by Messrs. Price, Waterhouse & Co.

WALTER J. FRANCIS & COMPANY
INCORPORATED IN CANADA
ENGINEERS AND ARCHITECTS
100 KING STREET WEST, TORONTO, ONT.
OTTAWA SYSTEM
PROGRESSIVE CAPITAL COSTS
The following table shows the progressive capital costs of the Ottawa System from 1911 to 1920.
WALTER J. FRANCIS & COMPANY
INCORPORATED IN CANADA



HYDRO-ELECTRIC INQUIRY COMMISSION
W. D. GREGORY, CHAIRMAN

ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

OTTAWA SYSTEM

PROGRESSIVE CAPITAL COSTS

Toronto, April 20th, 1923. Made by *W. J. F.*, Checked by *W. J. F.*

WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS

Table of Progressive Capital Costs

	Fiscal Years Ending October 31st.							
	1913 to 1915	1916	1917	1918	1919	1920	1921	1922
Metering Equipment	\$432	\$432	\$432	\$591	\$1,009	\$1,009	\$1,009	\$1,009
Rural Lines	-	-	-	-	-	-	4,698	*32,053
Totals	\$432	\$432	\$432	\$591	\$1,009	\$1,009	\$5,707	\$33,062

* To September 30th only.

It has been estimated that total funds of \$60,000 would be required during 1922 to complete the rural work undertaken and to extend further the rural transmission lines in Nepean Township, and that \$30,000 would be required for construction of additional rural lines on the System during 1923. It should be kept in mind that 50 per cent. of the cost of the primary rural lines may be borne by the Province, although to the end of 1922 the total cost has been entered in the books of the Commission.

Power Data.

The following table and the sheet of curves on page 27 have been prepared to show the characteristics of the Ottawa System in terms of horse-power. The figures are as follows:

Table of Horse-power Data

	Fiscal Years Ending October 31st.				
	1918	1919	1920	1921	1922
Purchased and Billed	5,829	6,158	6,764	7,654	9,135.7
Average of 12 Monthly Peaks	5,798.2	6,057.3	6,798.6	7,546.2	9,001.6
Maximum Yearly Peak	6,446	7,038	7,648	9,098	11,394

Table 1: List of variables used in the study

Category	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2423	2424	2425	2426	2427	2428	2429	2430	2431	2432	2433	2434	2435	2436	2437	2438	2439	2440	2441	2442	2443	2444	2445	2446	2447	2448	2449	2450	2451	2452	2453	2454	2455	2456	2457	2458	2459	2460	2461	2462	2463	2464	2465	2466	2467	2468	2469	2470	2471	2472	2473	2474	2475	2476	2477	2478	2479	2480	2481	2482	2483	2484	2485	2486	2487	2488	2489	2490	2491	2492	2493	2494	2495	2496	2497	2498	2499	2500	2501	2502	2503	2504	2505	2506	2507	2508	2509	2510	2511	2512	2513	2514	2515	2516	2517	2518	2519	2520	2521	2522	2523	2524	2525	2526	2527	2528	2529	2530	2531	2532	2533	2534	2535	2536	2537	2538	2539	2540	2541	2542	2543	2544	2545	2546	2547	2548	2549	2550	2551	2552	2553	2554	2555	2556	2557	2558	2559	2560	2561	2562	2563	2564	2565	2566	2567	2568	2569	2570	2571	2572	2573	2574	2575	2576	2577	2578	2579	2580	2581	2582	2583	2584	2585	2586	2587	2588	2589	2590	2591	2592	2593	2594	2595	2596	2597	2598	2599	2600	2601	2602	2603	2604	2605	2606	2607	2608	2609	2610	2611	2612	2613	2614	2615	2616	2617	2618	2619	2620	2621	2622	2623	2624	2625	2626	2627	2628	2629	2630	2631	2632	2633	2634	2635	2636	2637	2638	2639	2640	2641	2642	2643	2644	2645	2646	2647	2648	2649	2650	2651	2652	2653	2654	2655	2656	2657	2658	2659	2660	2661	2662	2663	2664	2665	2666	2667	2668	2669	2670	2671	2672	2673	2674	2675	2676	2677	2678	2679	2680	2681	2682	2683	2684	2685	2686	2687	2688	2689	2690	2691	2692	2693	2694	2695	2696	2697	2698	2699	2700	2701	2702	2703	2704	2705	2706	2707	2708	2709	2710	2711	2712	2713	2714	2715	2716	2717	2718	2719	2720	2721	2722	2723	2724	2725	2726	2727	2728	2729	2730	2731	2732	2733	2734	2735	2736	2737	2738	2739	2740	2741	2742	2743	2744	2745	2746	2747	2748	2749	2750	2751	2752	2753	2754	2755	2756	2757	2758	2759	2760	2761	2762	2763	2764	2765	2766	2767	2768	2769	2770	2771	2772	2773	2774	2775	2776	2777	2778	2779	2780	2781	2782	2783	2784	2785	2786	2787	2788	2789	2790	2791	2792	2793	2794	2795	2796	2797	2798	2799	2800	2801	2802	2803	2804	2805	2806	2807	2808	2809	2810	2811	2812	2813	2814	2815	2816	2817	2818	2819	2820	2821	2822	2823	2824	2825	2826	2827	2828	2829	2830	2831	2832	2833	2834	2835	2836	2837	2838	2839	2840	2841	2842	2843	2844	2845	2846	2847	2848	2849	2850	2851	2852	2853	2854	2855	2856	2857	2858	2859	2860	2861	2862	2863	2864	2865	2866	2867	2868	2869	2870	2871	2872	2873	2874	2875	2876	2877	2878	2879	2880	2881	2882	2883	2884	2885	2886	2887	2888	2889	2890	2891	2892	2893	2894	2895	2896	2897	2898	2899	2900	2901	2902	2903	2904	2905	2906	2907	2908	2909	2910	2911	2912	2913	2914	2915	2916	2917	2918	2919	2920	2921	2922	2923	2924	2925	2926	2927	2928	2929	2930	2931	2932	2933	2934	2935	2936	2937	2938	2939	2940	2941	2942	2943	2944	2945	2946	2947	2948	2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Amounts in U.S. dollars. For more information, see the notes to the consolidated financial statements.

our primary focus is on the impact of the 2001-2002 season on the 2002-2003 season.

These observations have been confirmed by the following experiments:

Approved for release by NSA on 05-10-2014 pursuant to E.O. 13526

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lines may be borne by the Province, although to the end of 1925 the total

cost has been entered in the books of the Commission.

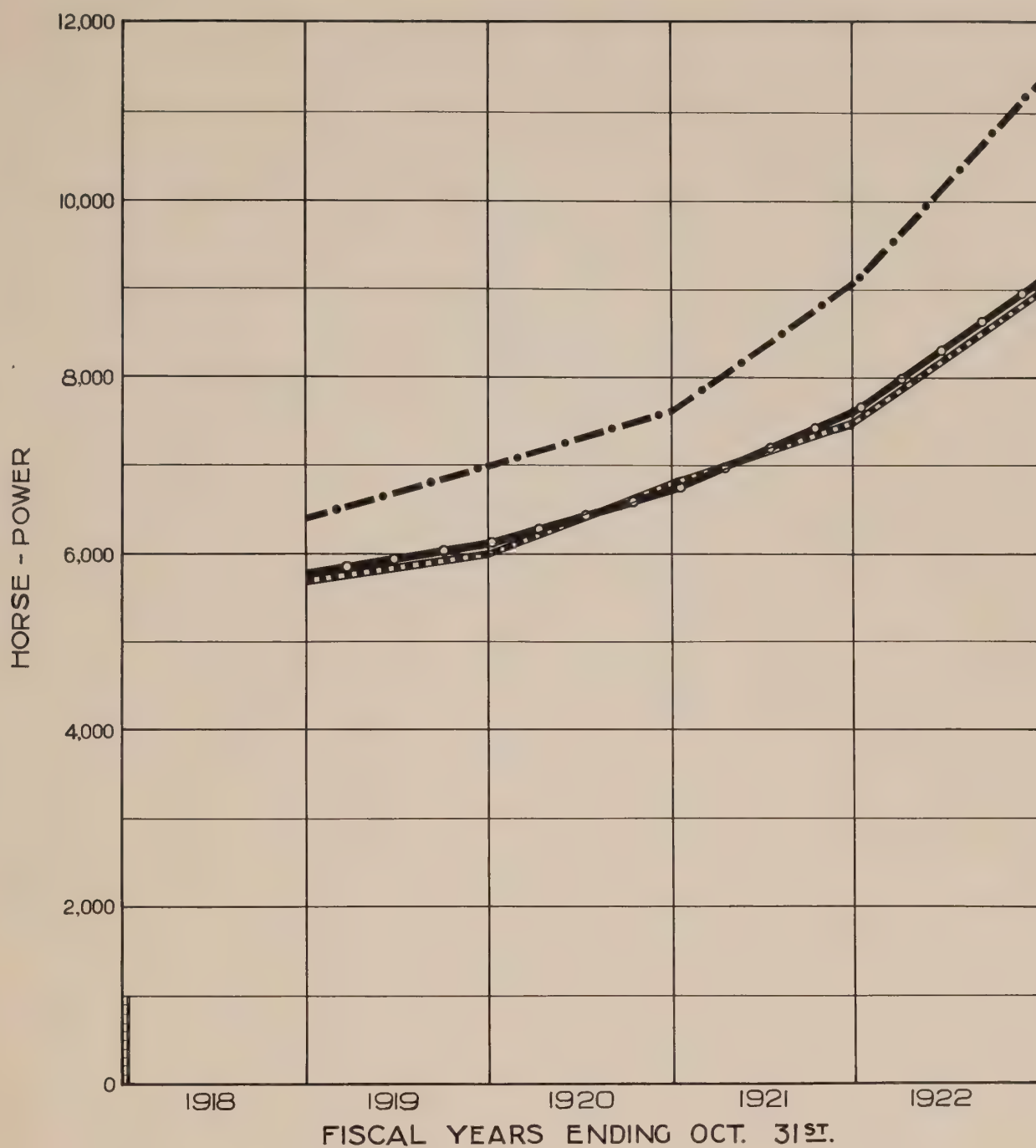
the estimated value and the actual value of the TV price from the company.

to show the administration of the Federal System in force in Germany. The

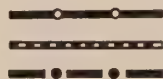
[illegible]

ATC TRANSMISSION TO ALC

Year	1960	1961	1962	1963	1964
Production of oil (million barrels)	1,100	1,200	1,300	1,400	1,500
Consumption of oil (million barrels)	1,200	1,300	1,400	1,500	1,600
Exports of oil (million barrels)	0	0	0	0	0
Imports of oil (million barrels)	0	0	0	0	0



H. P. PURCHASED AND BILLED
 H. P., AVERAGE OF 12 MONTHLY PEAKS
 H. P., MAXIMUM YEARLY PEAKS



HYDRO-ELECTRIC INQUIRY COMMISSION
 W. D. GREGORY, CHAIRMAN

ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

OTTAWA SYSTEM

HORSE-POWER DATA

Toronto, April 20th, 1923. Made by *WJF* Checked by *L.H.*

WALTER J. FRANCIS & COMPANY
 CONSULTING ENGINEERS

It will be noted that there are four different classes of horse-power shown in the table and on the diagram. These may be explained as follows:

Purchased Horse-power.

The figures for plotting the curve showing purchased horse-power were obtained from the records of the Hydro-Electric Power Commission and represent the amount purchased from the Ottawa & Hull Power & Manufacturing Company in each of the years 1918 to 1922. It is stipulated in the contract with the Power Company that power is to be reserved in blocks of 500 horse-power until 18,000 horse-power has been ordered, the ultimate amount of power purchasable being 20,000 horse-power. The Commission is to pay for a minimum of 75 per cent. of the power ordered when the power taken falls below that amount.

Billed Horse-power.

The curve of billed horse-power coincides with that of purchased horse-power, the Corporation of the City of Ottawa having been billed with the same number of horse-power as was billed to the Commission by the Power Company. These figures agree with the horse-power billed as shown on page 8 of the Price, Waterhouse & Co. report.

Average Monthly Peaks.

The curve of average monthly peaks was obtained by taking the twelve

It will be noted that there are four different classes of personnel mentioned in the table and on the diagram. These may be classified as follows:

Personnel Categories

The Bureau has classified the data relating to personnel into four categories: (1) Active Personnel, (2) Reserve Personnel, (3) Retired Personnel, and (4) Honorary Personnel. The data for Active Personnel is shown in the table for the years 1922 to 1926. It is estimated that the number of Active Personnel in the Navy is about 100,000. The Reserve Personnel is shown in the table for the years 1922 to 1926. It is estimated that the number of Reserve Personnel in the Navy is about 50,000. The Retired Personnel is shown in the table for the years 1922 to 1926. It is estimated that the number of Retired Personnel in the Navy is about 20,000. The Honorary Personnel is shown in the table for the years 1922 to 1926. It is estimated that the number of Honorary Personnel in the Navy is about 10,000.

Summary of Personnel Data

The above is a summary of the data relating to personnel in the Navy. The data is classified into four categories: Active Personnel, Reserve Personnel, Retired Personnel, and Honorary Personnel. The data for Active Personnel is shown in the table for the years 1922 to 1926. It is estimated that the number of Active Personnel in the Navy is about 100,000. The Reserve Personnel is shown in the table for the years 1922 to 1926. It is estimated that the number of Reserve Personnel in the Navy is about 50,000. The Retired Personnel is shown in the table for the years 1922 to 1926. It is estimated that the number of Retired Personnel in the Navy is about 20,000. The Honorary Personnel is shown in the table for the years 1922 to 1926. It is estimated that the number of Honorary Personnel in the Navy is about 10,000.

Conclusion

The above is a summary of the data relating to personnel in the Navy. The data is classified into four categories: Active Personnel, Reserve Personnel, Retired Personnel, and Honorary Personnel. The data for Active Personnel is shown in the table for the years 1922 to 1926. It is estimated that the number of Active Personnel in the Navy is about 100,000. The Reserve Personnel is shown in the table for the years 1922 to 1926. It is estimated that the number of Reserve Personnel in the Navy is about 50,000. The Retired Personnel is shown in the table for the years 1922 to 1926. It is estimated that the number of Retired Personnel in the Navy is about 20,000. The Honorary Personnel is shown in the table for the years 1922 to 1926. It is estimated that the number of Honorary Personnel in the Navy is about 10,000.

monthly peaks for each year as shown in the records of the Hydro-Electric Power Commission of Ontario, and dividing the sum of the monthly peaks by twelve to get a yearly average monthly peak. Each of these averages was then plotted as a single point for the average monthly peak of each year. These figures would conform to the horse-power purchased and billed, but for the fact that during the months of July, 1918, June, July and August of 1919, July and August of 1921, and July and August of 1922, the power taken was less than the minimum contracted for. A small discrepancy also appears in the amount of power billed to the System in 1920. As will be seen from the table of horse-power data, the average of the twelve monthly peaks for that year was 35 horse-power more than the amount billed.

Maximum Yearly Peaks.

The curve showing the maximum yearly peaks was plotted directly from the operating records for each year from the same source as used for the derivation of the curve of average monthly peaks.

Capital Costs per Horse-power Purchased.

The following table indicates the fractional capital costs per horse-power purchased, from the years 1918 to 1922 inclusive, based on the figures showing the capital costs of the System and the horse-power data given above.

Table of Capital Costs per Horse-power Purchased

	Fiscal Years Ending October 31st,				
	1918	1919	1920	1921	1922
Metering Equipment	\$0.10	\$0.16	\$0.15	\$0.13	\$0.11
Rural Lines	-	-	-	.61	3.51
Totals	\$0.10	\$0.16	\$0.15	\$0.74	\$3.62

It will be noted that the table of capital costs per horse-power has nothing for generating stations, nothing for high voltage transmission lines, and nothing for distributing stations, as there are none of these on the System.

COPY

Total Annual Revenues.

The following table and the sheet of curves included as page 31 give the total revenues of the Ottawa System, and have been prepared by using the figures given in Exhibit IV of the report of Messrs. Price, Waterhouse & Co. already mentioned, for the years 1918 to 1921 inclusive.

The City of Ottawa was charged with the cost of power together with operating expenses and that portion of the fixed charges which pertained to the power supply.

Table of Total Annual Revenues

Period Ending October 31st	Total Revenues per Annum
1918	\$ 82,276
1919	86,844
1920	95,622
1921	104,068

TOTAL ANNUAL REVENUES

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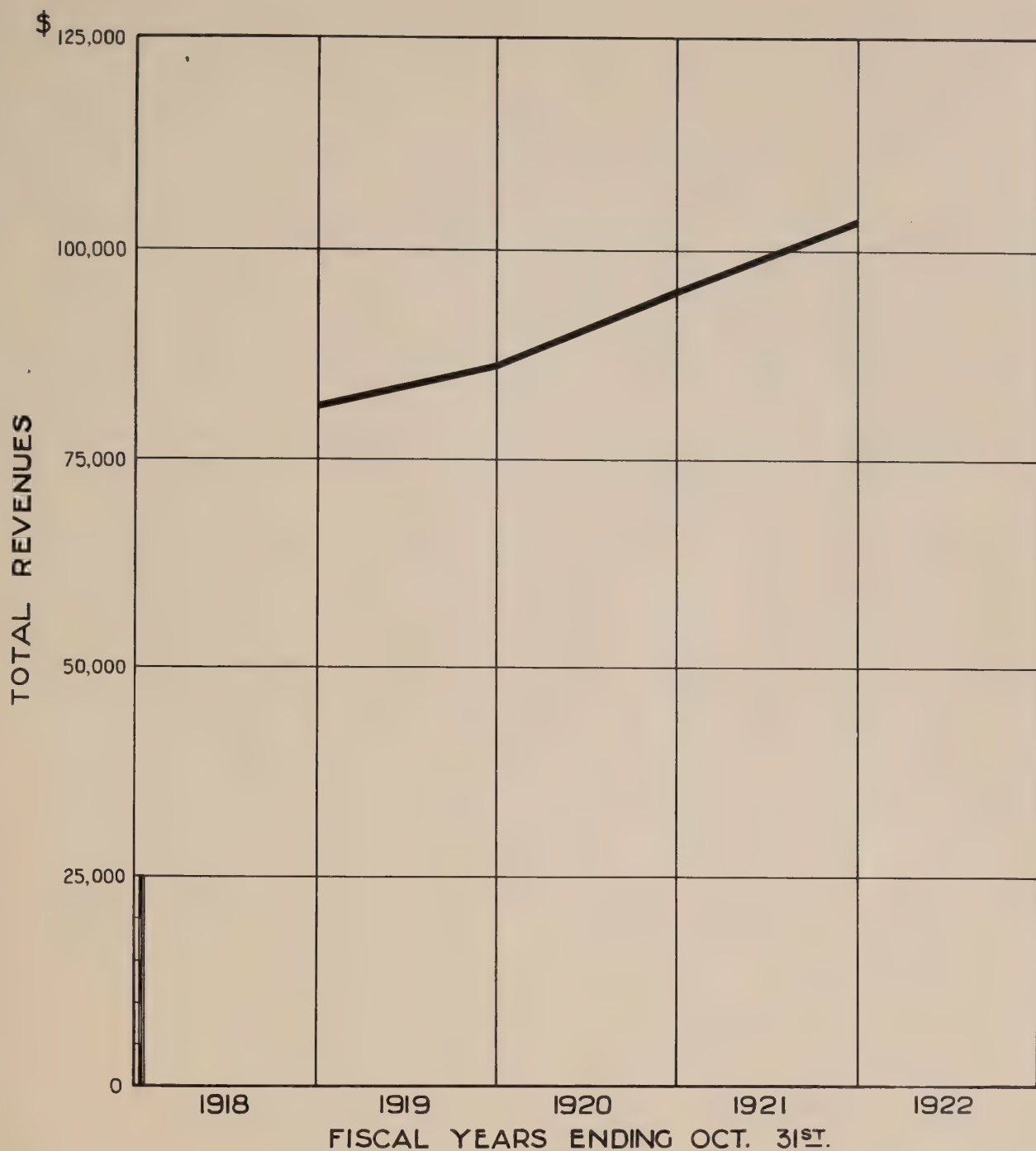
Year	1961	1962	1963	1964	1965
1966	1967	1968	1969	1970	1971
1972	1973	1974	1975	1976	1977
1978	1979	1980	1981	1982	1983
1984	1985	1986	1987	1988	1989
1990	1991	1992	1993	1994	1995
1996	1997	1998	1999	2000	2001
2002	2003	2004	2005	2006	2007
2008	2009	2010	2011	2012	2013
2014	2015	2016	2017	2018	2019
2020	2021	2022	2023	2024	2025
2026	2027	2028	2029	2030	2031
2032	2033	2034	2035	2036	2037
2038	2039	2040	2041	2042	2043
2044	2045	2046	2047	2048	2049
2050	2051	2052	2053	2054	2055
2056	2057	2058	2059	2060	2061
2062	2063	2064	2065	2066	2067
2068	2069	2070	2071	2072	2073
2074	2075	2076	2077	2078	2079
2080	2081	2082	2083	2084	2085
2086	2087	2088	2089	2090	2091
2092	2093	2094	2095	2096	2097
2098	2099	2100	2101	2102	2103
2104	2105	2106	2107	2108	2109
2110	2111	2112	2113	2114	2115
2116	2117	2118	2119	2120	2121
2122	2123	2124	2125	2126	2127
2128	2129	2130	2131	2132	2133
2134	2135	2136	2137	2138	2139
2140	2141	2142	2143	2144	2145
2146	2147	2148	2149	2150	2151
2152	2153	2154	2155	2156	2157
2158	2159	2160	2161	2162	2163
2164	2165	2166	2167	2168	2169
2170	2171	2172	2173	2174	2175
2176	2177	2178	2179	2180	2181
2182	2183	2184	2185	2186	2187
2188	2189	2190	2191	2192	2193
2194	2195	2196	2197	2198	2199
2200	2201	2202	2203	2204	2205
2206	2207	2208	2209	2210	2211
2212	2213	2214	2215	2216	2217
2218	2219	2220	2221	2222	2223
2224	2225	2226	2227	2228	2229
2230	2231	2232	2233	2234	2235
2236	2237	2238	2239	2240	2241
2242	2243	2244	2245	2246	2247
2248	2249	2250	2251	2252	2253
2254	2255	2256	2257	2258	2259
2260	2261	2262	2263	2264	2265
2266	2267	2268	2269	2270	2271
2272	2273	2274	2275	2276	2277
2278	2279	2280	2281	2282	2283
2284	2285	2286	2287	2288	2289
2290	2291	2292	2293	2294	2295
2296	2297	2298	2299	2300	2301
2302	2303	2304	2305	2306	2307
2308	2309	2310	2311	2312	2313
2314	2315	2316	2317	2318	2319
2320	2321	2322	2323	2324	2325

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The following table and the sheet of curves included on page 31 give the total revenue of the Boston Division, the total operating expenses, the operating expenses and that portion of the fixed charges which pertained to the power supply.

continued to work hard to assist



HYDRO-ELECTRIC INQUIRY COMMISSION
 W. D. GREGORY, CHAIRMAN
 ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS
OTTAWA SYSTEM
TOTAL ANNUAL REVENUES
 Toronto, April 20th., 1923. Made by *W.D.*, Checked by *L.H.*
WALTER J. FRANCIS & COMPANY
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Total Annual Costs of Power.

The table on page 34 shows the cost of power subdivided under various headings for the years 1918 to 1921 inclusive, while the sheet of curves included as page 33 shows these figures plotted in graphic form.

The headings under which the various costs have been grouped are as follows:

Power Purchased.

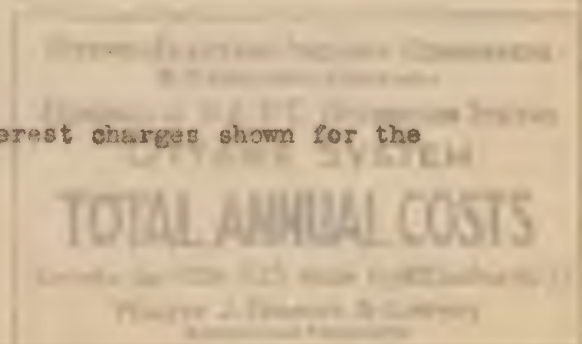
A separate heading for power purchased has been included for the reason that there is no power generated on this System by the Commission, and the cost of the power purchased comprises practically all the annual costs of power. The figure shown for each year is the total amount of the charges for power purchased from the Ottawa & Hull Power & Manufacturing Company.

Overhead and General Expense.

Under the heading of overhead and general expense are included such items as salaries of executives, printing and stationery, legal expense and so forth, all in accordance with the item headed "Operating Expenses", contained in Exhibit IV of the Price, Waterhouse & Co. report.

Interest and Sinking Fund.

The figures for interest include all interest charges shown for the



Following

• *Leptocarpus* sp.

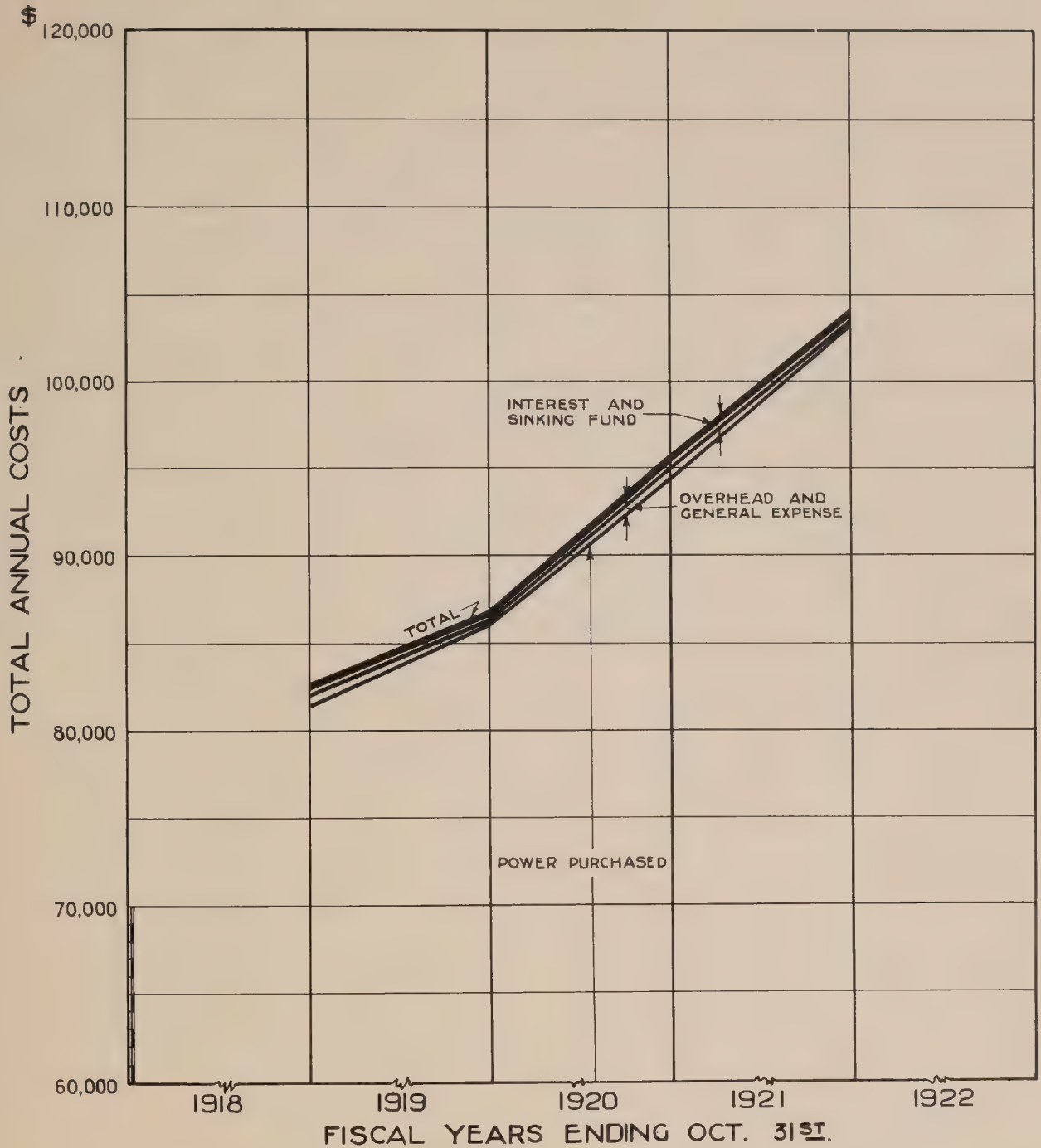
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valued in Exhibit IV of the Price, Caterpillar & Co. report.

1904-1905

The figures for interest include all interest charges shown for the



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ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

OTTAWA SYSTEM

TOTAL ANNUAL COSTS

Toronto, April 20th, 1923. Made by *WJF* Checked by *WJF*

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capital invested in the System. The figures for sinking fund have been transferred directly from the report.

The figures for the various items are as follows:

Table of Total Annual Costs of Power

	Fiscal Years Ending October 31st,			
	1918	1919	1920	1921
Power Purchased	\$81,611	\$86,218	\$94,700	\$103,329
Overhead & General Expense	627	572	854	690
Interest	28	40	50	51
Sinking Fund	10	14	18	18
Totals	\$82,276	\$86,844	\$95,622	\$104,088

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Owing to the fact that the power purchased was delivered directly to the consumer on the System, the Corporation of the City of Ottawa, there have been no expenditures chargeable against operation costs. There being very little property on the System that is owned by the Commission there was also no expenditure for maintenance. These items have, therefore, not been included in the table of total annual costs of power. The items of renewals and contingencies which are also not contained in the table above will be discussed later.

Percentage Costs of Power.

The following table and the sheet of curves included as page 35 show the annual cost figures as percentages of the total cost of power per annum,

OTTAWA SYSTEM
ANNUAL COSTS SUBDIVIDED
BY PERCENTAGES

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Reported directly from the report.

The figures for the various items are as follows:

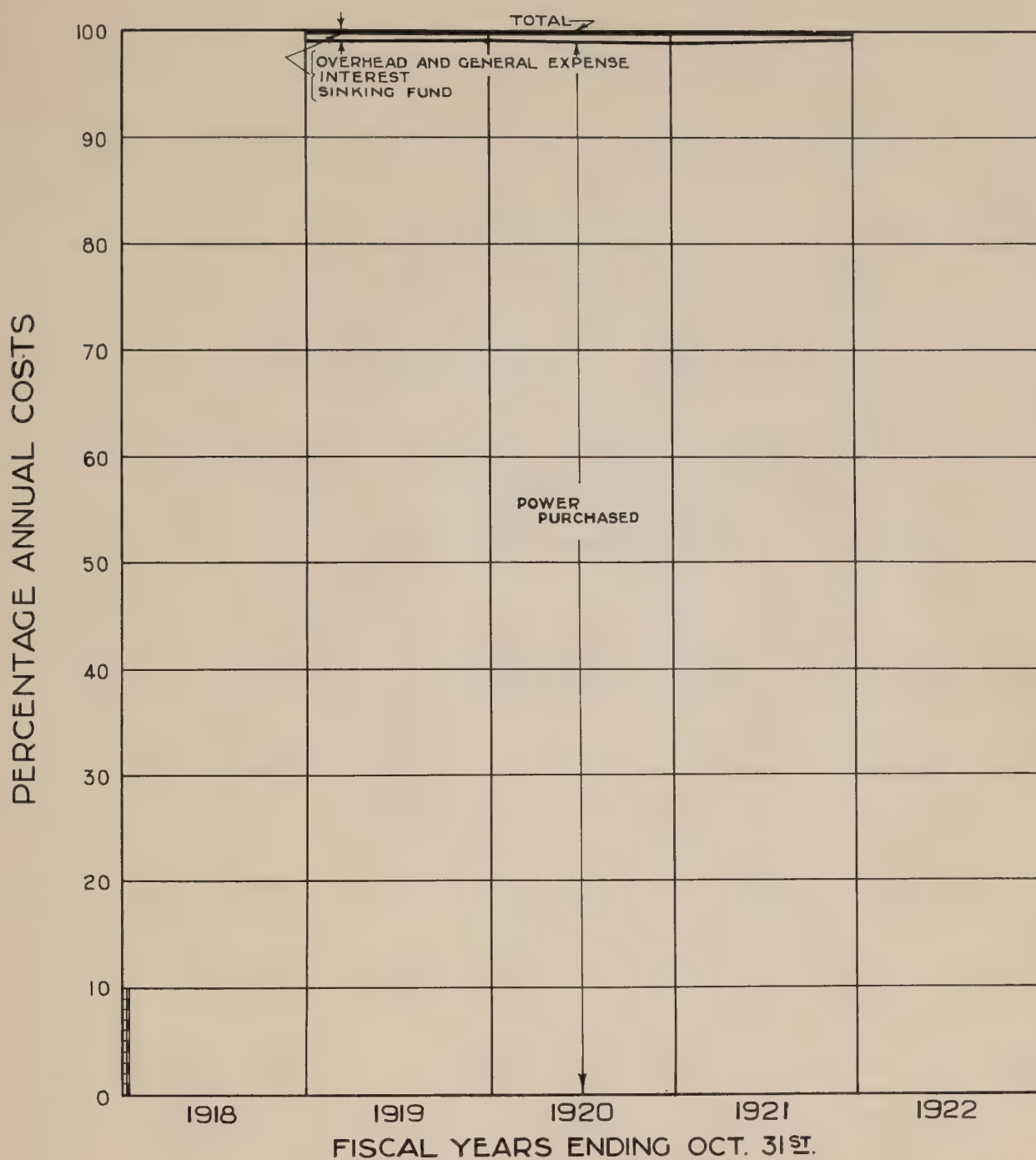
Table of Total Annual Costs of Power

	1978	1979	1980	1981
Total	\$62,256	\$68,844	\$62,522	\$104,008
Statewide Fund	10	15	15	15
Interest	28	40	20	18
Operating & Capital Expenses	22	29	27	75
Fund Balance	112,124	113,280	107,400	100,000

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Discussed later.

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HYDRO-ELECTRIC INQUIRY COMMISSION
W. D. GREGORY, CHAIRMAN

ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

OTTAWA SYSTEM

**ANNUAL COSTS SUBDIVIDED
BY PERCENTAGES**

Toronto, April 20th, 1923. Made by *W.J.F.*, Checked by *L.H.*

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and these are included as a method of comparison with other systems or similar properties:

Table of Annual Costs Subdivided by Percentages

	Fiscal Years Ending October 31st.			
	1918	1919	1920	1921
Power Purchased	99.20	99.27	99.05	99.28
Overhead & General Expense	0.76	0.66	0.89	0.66
Interest	0.03	0.06	0.05	0.05
Sinking Fund	0.01	0.01	0.01	0.01
Totals	100.0%	100.0%	100.0%	100.0%

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Analysis of Reserve Accounts.

Renewals Account.

There has been no provision made to date for renewals of properties in the Ottawa System, it having been stated that in the opinion of the engineers of the Commission no provision was considered necessary. In future, however, a renewals account will probably be set up for rural lines.

It is understood that it is the practice of the Hydro-Electric Power Commission to spend sufficient money on maintenance account each year so as to keep each and every portion of the System in a condition to operate in accordance with the requirements of economical production, which it is stated is considered to be about seventy-five per cent. as good as its original new condition. This being so, it was considered in this report that a renewals account should be studied in connection with the estimated useful life of

meters and rural transmission lines, and applied to the renewal of only twenty-five per cent. of the capital concerned.

A question that should receive consideration in determining these reserves for renewals is the proper rate of interest to be chosen in estimating the earning power of the credits in the reserve funds. A strict theory of the earning power of the renewal fund would take into consideration not only the method of investing the fund, for example, whether it be used in making extensions and betterments in the System, or invested in separate securities and treated like a trust fund, but also the rate of annual interest which should be adjusted each year in accordance with the actual value of the money.

At October 31st, 1921, the total depreciable capital was the whole of the capital investment, namely about \$6,000, while no reserve for renewals had yet been established at that date. At September 30th, 1922, the depreciable capital was about \$33,000, and if the proposed extensions be carried out will be about \$96,000 at October 31st, 1923, unless the Province assumes part of the costs of the rural lines, which would correspondingly reduce the depreciable capital.

Sinking Fund.

The study of the finances of the System shows that \$88.62 has been set aside as sinking fund to provide for the financial obligations concerning the properties. No sinking fund reserve has yet been made in respect of rural lines, which it is expected will comprise the greatest portion of the capital expenditures as long as no power is generated on the Ottawa System by the

Commission. The first rural line expenditure was made in 1921, so that the collection of the sinking fund reserve chargeable against rural lines can be commenced only in 1926 or 1927.

Reserve for Contingencies.

Up to the end of 1921 no reserve for contingencies had been established.

Having in mind the contemplated extended construction of rural lines and the heavy losses which might be occasioned to them through catastrophe, it is felt that a suitable rate per horse-power consumed should be charged to rural customers or some other means found so that a sufficient fund might be available to be drawn on in case of emergencies. When a fund of about \$5,000 will have been built up, the rates can be readjusted to suit the conditions found after several further years of experience.

Discussion of Deficits and Surpluses.

The records show that the System as a whole has been billed with the cost of power in accordance with the book-keeping methods of the Hydro-Electric Power Commission since 1907, and that there are now no deficits nor surpluses for the System as a whole. This does not take into account the local distribution in the City of Ottawa which is done by a separate Commission in that city, and where the profits or losses are not included in the accounts of the Hydro-Electric Power Commission for the Ottawa System.

Revenues and Costs per Horse-power per Annum.

In order to reduce the total revenues and total costs of operation to a basis where these would be comparable with other systems, and to agree with the usual practice of other companies and of distribution authorities, a table of figures has been prepared to show the revenue per horse-power per annum for different bases of horse-power.

In a similar way the total costs have been reduced to costs per horse-power per annum for different bases of horse-power, and have also been analyzed to show the total annual costs subdivided into fractional amounts chargeable against each kind of expense based on the amount of horse-power purchased. Because of the fact that the amounts of horse-power purchased and horse-power billed are the same, only one table and diagram of subdivided costs have been included herein.

The following series of diagrams with the tables of figures for each show the various items in detail.

Revenues per Horse-power per Annum.

The revenues for each of the various classifications of horse-power are given in the following table:

Table of Revenues per Horse-power per Annum

	Fiscal Years Ending October 31st.			
	1918	1919	1920	1921
Purchased and Billed	\$14.11	\$14.10	\$14.14	\$13.60
Average Twelve Monthly Peaks	14.19	14.34	14.06	13.79
Maximum Yearly Peak	12.76	12.34	12.52	11.44

Annual Costs per Horse-power.

The following tables and the two sheets of curves included as pages 42 and 43 show the details of the costs per horse-power per annum on different bases. The figures from which these curves were plotted are the figures for the operating costs given in the table on page 34 divided by the figures for the various classes of horse-power already given in the text. The table below and the sheet of curves included as page 42 indicate the total costs per horse-power per annum for the different classifications of horse-power already discussed. It will be noted that the total costs per horse-power per annum balance with the total revenues per horse-power for the whole term of years for which revenues and costs are available.

The sheet of curves on page 43 entitled "Subdivided Costs per Horse-power Purchased and Billed" indicates the subdivision of the total annual costs as between power purchased and billed, overhead and general expense, interest and sinking fund, divided by the total amounts of horse-power purchased by the Commission and sold to the City of Ottawa.

Table of Total Costs per Horse-power per Annum

	Fiscal Years Ending October 31st,			
	1918	1919	1920	1921
Purchased and Billed	\$14.11	\$14.10	\$14.14	\$13.60
Average Twelve Monthly Peaks	14.19	14.34	14.06	13.79
Maximum Yearly Peak	12.76	12.34	12.52	11.44

For which revenues and costs are available.

The assets of the company are being sold to the City of Chicago Commission and sold to the City of Chicago.

Table of Subdivided Costs per Horse-power Purchased and Billed

	Fiscal Years Ending October 31st,			
	1918	1919	1920	1921
Power Purchased	\$14.00	\$14.00	\$14.00	\$13.50
Overhead and General Expense	.11	.09	.13	.09
Interest and Sinking Fund	-	.01	.01	.01
Totals	\$14.11	\$14.10	\$14.14	\$13.60

Kilowatt-hour Data.

The engineers of the Hydro-Electric Power Commission state that there is no record available of the total kilowatt-hours supplied to the Ottawa System.

The following table shows the kilowatt-hours per consumer for domestic use and for commercial lighting, and also shows the number of horse-power per power consumer served by the Corporation of the City of Ottawa during the years 1914 to 1921 inclusive. The diagrams included as page 44 show this data in graphic form.

Table of Various Classes of Power Consumption
by the Corporation of the City of Ottawa

	FISCAL YEARS Ending October 31st,							
	1914	1915	1916	1917	1918	1919	1920	1921
K.W.H. per Domestic Consumer	217	241	269	275	368	538	631	810
K.W.H. per Commercial Light Consumer	1,248	1,416	1,615	1,757	1,995	2,670	2,548	2,723
Horse-power per Power Consumer	-	-	-	17.4	22.9	21.5	21.6	20.6

Table of Distribution of the City of Chicago, 1911

Total Distribution of the City of Chicago, 1911			
Year	1910	1911	1912
Total Distribution	1,000,000	1,000,000	1,000,000
Water	1,000,000	1,000,000	1,000,000
Electricity	1,000,000	1,000,000	1,000,000
Gas	1,000,000	1,000,000	1,000,000
Telephone	1,000,000	1,000,000	1,000,000
Streetcar	1,000,000	1,000,000	1,000,000
Tramway	1,000,000	1,000,000	1,000,000
Other	1,000,000	1,000,000	1,000,000

Table of Distribution of the City of Chicago, 1911

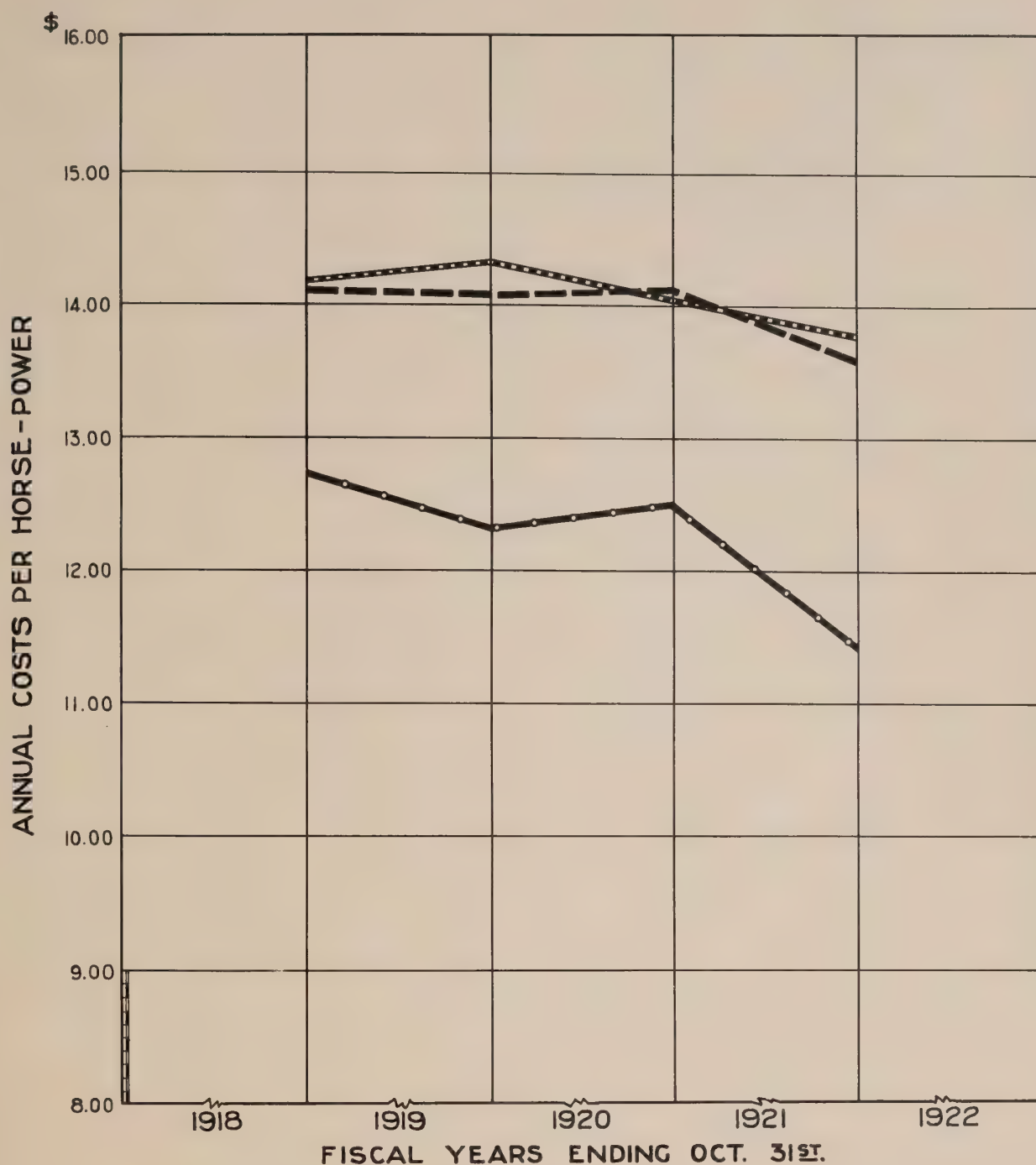
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The following table shows the distribution of the City of Chicago, 1911, in various forms. The total distribution of the City of Chicago, 1911, is 1,000,000. The distribution of the City of Chicago, 1911, is as follows:

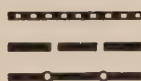
Water 1,000,000
Electricity 1,000,000
Gas 1,000,000
Telephone 1,000,000
Streetcar 1,000,000
Tramway 1,000,000
Other 1,000,000

Table of Distribution of the City of Chicago, 1911

Total Distribution of the City of Chicago, 1911			
Year	1910	1911	1912
Total Distribution	1,000,000	1,000,000	1,000,000
Water	1,000,000	1,000,000	1,000,000
Electricity	1,000,000	1,000,000	1,000,000
Gas	1,000,000	1,000,000	1,000,000
Telephone	1,000,000	1,000,000	1,000,000
Streetcar	1,000,000	1,000,000	1,000,000
Tramway	1,000,000	1,000,000	1,000,000
Other	1,000,000	1,000,000	1,000,000



H. P., AVERAGE OF 12 MONTHLY PEAKS
 H. P. PURCHASED AND BILLED
 H. P., MAXIMUM YEARLY PEAK



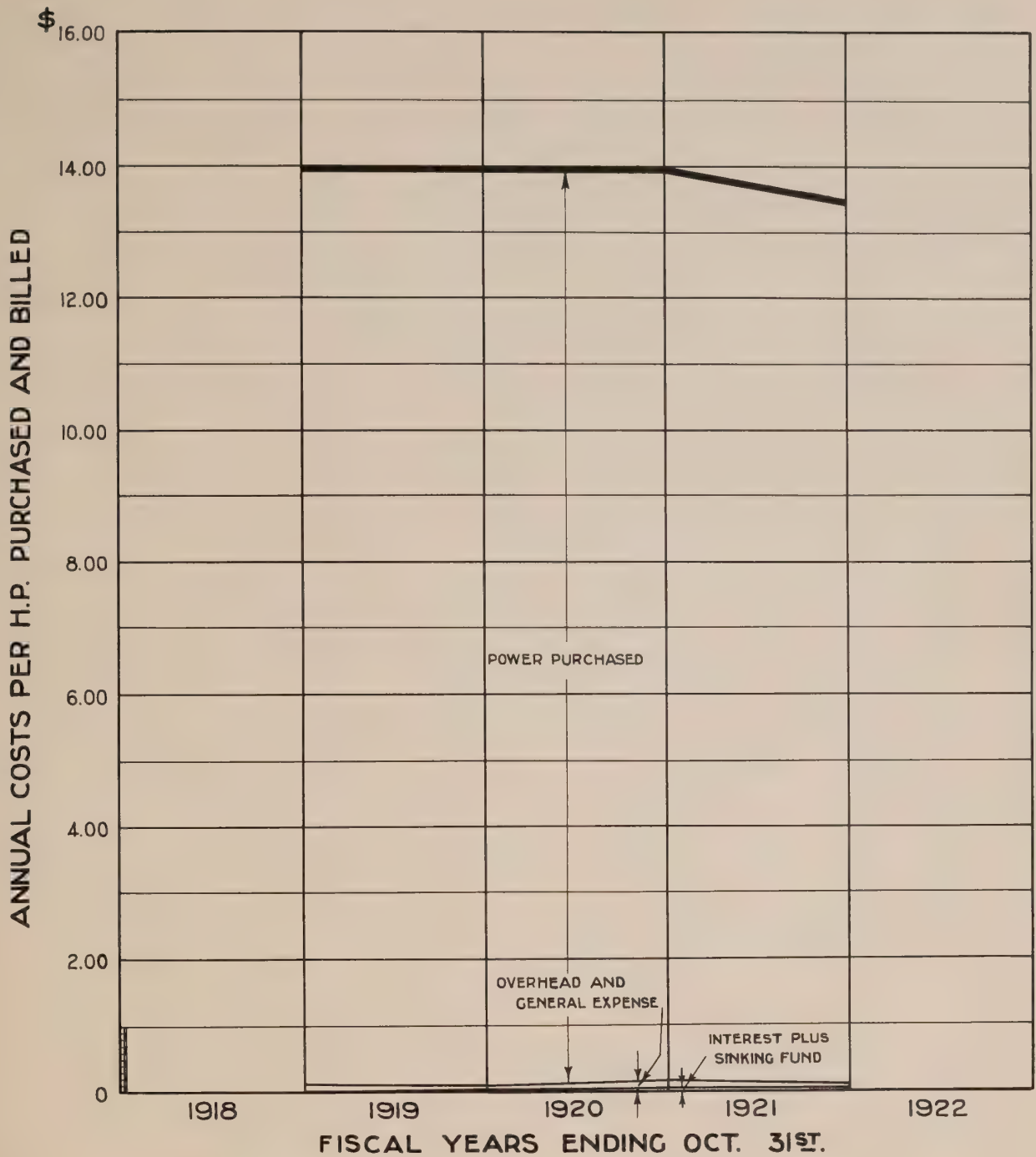
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ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

**OTTAWA SYSTEM
 COSTS PER H.P. PER ANNUM
 VARIOUS H. P. BASES**

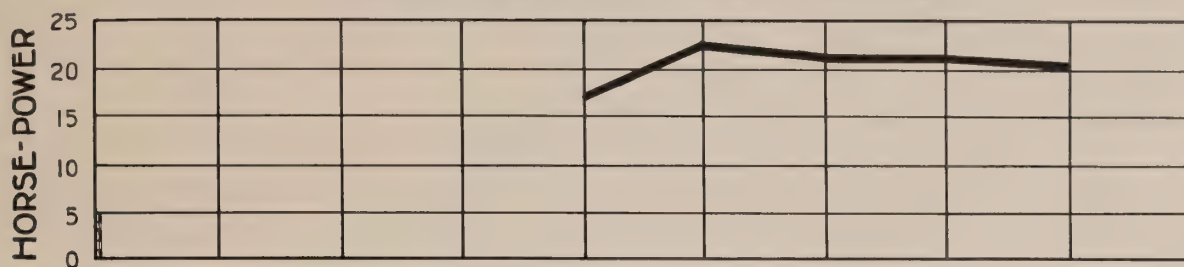
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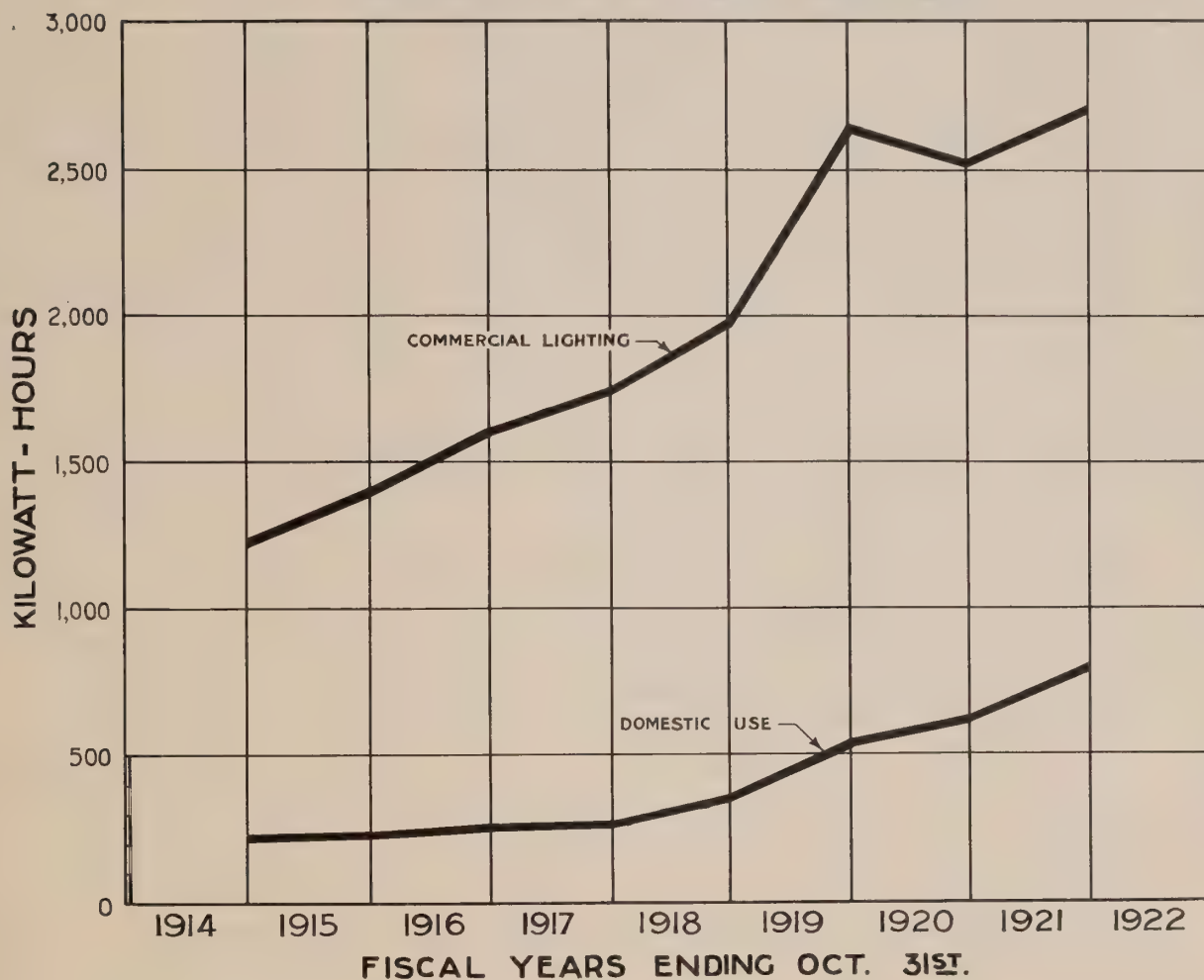


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W. D. GREGORY, CHAIRMAN
ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS
OTTAWA SYSTEM
SUBDIVIDED COSTS PER ANNUM
PER H.P. PURCHASED
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HORSE-POWER PER POWER CONSUMER



KILOWATT-HOURS PER CONSUMER



HYDRO-ELECTRIC INQUIRY COMMISSION
W. D. GREGORY, CHAIRMAN

ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

OTTAWA SYSTEM

**KILOWATT-HOUR DATA
AND H.P. PER POWER CONSUMER**

Toronto, April 20th., 1923. Made by *W.J.F.*, Checked by *L.H.*

WALTER J. FRANCIS & COMPANY
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Summary.

A summary of a number of the more salient points which have been studied and discussed in the foregoing report may be of advantage in continuing the consideration of the economics of the Ottawa System. They are as follows:

- (1) The capital costs of the Ottawa System are very small. At October 31st, 1921, the only properties owned by the Commission were meters installed in one of the generating stations of the Ottawa & Hull Power & Manufacturing Company.
- (2) Capital costs projected for 1922 and 1923 amounting to about \$90,000 would make the total investment in the Ottawa System approximately \$96,000 at October 31st, 1923. The whole of this amount for extensions is for completion and addition to the rural lines now under construction.
- (3) To facilitate future economic studies and to assist in operating efficiency it would be well to keep accurate records of kilowatt-hours used at each principal consuming point on the System.
- (4) The market for power is divided in the district between the Hydro-Electric Power Commission and other interests. The total population served by all at the present time is about ninety per cent. of that of the district. The use of electricity per ordinary consumer is apparently greater in this district than in many others. The continual growth in load indicates that the demands are growing, and it is likely that a considerable increase in the power demand can take place in the district.

The ultimate demand of the Ottawa System and district can be taken care of by the development of local power sites, the capacity of which amounts to one million horse-power or more.

Power transmitted from the sites in the vicinity of Ottawa can be readily a solution of the problem of source of power to supply the ultimate demands of the Rideau and St. Lawrence Systems. Interconnecting lines between the three systems would make this feasible without the necessity of expenditures for very much additional equipment, as the transforming and distributing stations of the Rideau and St. Lawrence Systems are both designed to operate at 44,000 volts. The frequency of the power generated by all the important plants in the Ottawa district is 60 cycles, similar to that of the power used in the three above mentioned systems.

- (5) A reserve for renewals should be established after carefully considering the estimated useful life of the meters and rural lines now being constructed in the System, and also adjusted to allow for the actual cost of money year by year.
- (6) The question of sinking fund should be considered in relation to the term of years in which a fund is to be built up, that will be sufficient to provide for the proportionate amount of capital costs chargeable against the Corporation of the Township of Nepean. The agreement with the Commission specifies a term of twenty years, whereas that section of the Power Commission Act which pertains thereto specifies a thirty-year term at the end of which the proportion of the capital costs chargeable against the Township are to be paid off.
- (7) No reserve for contingencies has as yet been established. It was suggested in this report that a charge per horse-power delivered to the rural customers should be included in the cost of power and yearly results noted, so that when a fund will have been built up ample to provide for damage to the rural lines due to catastrophe and accidents, a proper yearly allowance for the fund might eventually be devised.
- (8) The operating records indicate that the System as a whole is being operated so as to supply power at cost, there being no difference between the total revenues and the total costs as shown on the Commission's books.

Walter J. Francis

Consulting Engineer.

Toronto, April 20th, 1923.

(1) A reserve for removals should be established after carefully considering the estimated useful life of the assets and their times now being estimated in the future. The estimate is also an estimate of the value of the assets.

(2) The management should also consider the possibility of the assets being used for other purposes. It is suggested that the assets be classified as follows: (a) Assets which are used for the primary purpose of the business; (b) Assets which are used for other purposes; (c) Assets which are used for other purposes. The management should also consider the possibility of the assets being used for other purposes. It is suggested that the assets be classified as follows: (a) Assets which are used for the primary purpose of the business; (b) Assets which are used for other purposes; (c) Assets which are used for other purposes.

(3) No reserve for contingencies has as yet been established. It is suggested in this report that a reserve for contingencies be established. The management should also consider the possibility of the assets being used for other purposes. It is suggested that the assets be classified as follows: (a) Assets which are used for the primary purpose of the business; (b) Assets which are used for other purposes; (c) Assets which are used for other purposes.

(4) The management should also consider the possibility of the assets being used for other purposes. It is suggested that the assets be classified as follows: (a) Assets which are used for the primary purpose of the business; (b) Assets which are used for other purposes; (c) Assets which are used for other purposes.

W. J. [Signature]
[Signature]
[Signature]

Toronto, April 30th, 1955.

